DRAFT FINAL WORK PLAN

ROCKY MOUNTAIN ARSENAL

OFFPOST PRIVATE WELL INVENTORY,

SAMPLING

AND

INFORMATION RESPONSE PROGRAM

FEBRUARY, 1991

Tri-County Health Department
Serving Adams, Arapahoe and Douglas Counties
4301 E. 72nd Avenue
Commerce City, Colorado 80022

Prepared for:

U.S. Department of Army
Program Manager, Rocky Mountain Arsenal
Commerce City, Colorado

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Tri-County Health Department

Serving Adams, Arapahoe and Douglas Counties

Hugh Rohrer, M.D., M.P.H.
Director

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March 8, 1991

Mr. Charles T. Scharmann
Office of the Program Manager
Rocky Mountain Arsenal
Commerce City, CO 80022-2180

Dear Mr. Scharmann:

Enclosed is one copy of the Draft Final: Work Plan, Tri-County Health Department Rocky Mountain Arsenal Supplementary Offpost Private Well Inventory, Sampling and Information Response Program, dated February, 1991 for your preliminary review and comment. We ask that all comments be submitted to this department by April 30, 1991.

As always, we are ready to meet with you at your convenience to discuss this project.

Sincerely,

Kenneth L. Conright
Environmental Health Supervisor

KLC:dmk

cc: Chris Wiant
Bruce Wilson
Daniel E. Collins

A-1

TABLE OF CONTENTS

TABLE OF CONTENTS

Continued - Page 2

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

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1.0 INTRODUCTION

This Work Plan is an offpost private well inventory of the area north, northwest and west of Rocky Mountain Arsenal (RMA) which is shown on Figure 1. The inventory area is bounded on the south by 80th Avenue (offpost areas only), on the west by the South Platte River, on the east by Second Creek, and on the north by the convergence of Second Creek with the South Platte River (Figure 2). Based on previous investigations by others (i.e., ESE, 1985, 1986, 1987, and ESE and HLA, 1989), the inventory area was defined so as to encompass the area of offpost RMA-related chemical contamination in ground water to the north, northwest and west of RMA (Figure 2), as well as to include additional "buffer" areas of up to about two miles beyond the area of RMA related ground water contamination. Tri-County Health Department (TCHD) previously performed a well survey (TCHD, 1990) for the area north and northwest of the RMA boundary (Figure 2) to identify private wells and to define the well use(s). The previous work enabled prioritization of the wells for subsequent sampling and analysis for RMA-related chemicals, which will be performed in the work program described herein. Based on the results of previously performed laboratory testing results, (ESE, 1985, 1986, 1987, and ESE and HLA 1989), offpost RMA-related ground water contamination is generally limited to shallow (less than 100-feet deep) ground water to the north, northwest and west of RMA. The deep aquifers (generally greater than 100 feet), are for the most part not contaminated by RMA related chemicals.

2.0 BACKGROUND AND HISTORY

Rocky Mountain Arsenal (RMA) occupies approximately 27 square miles of southwestern Adams County, Colorado. RMA is located within the Denver Metropolitan Area north of the City of Denver and East of Commerce City. RMA is bounded by East 56th Avenue on the south, East 96th Avenue on the north, Highway 2 on the northwest, Quebec Street on the west and Buckley Road on the east (Figure 2).

RMA was established in 1942 for the production of chemical agent munitions. Throughout World War II, chemical intermediate and toxic end-item products and incendiary munitions were manufactured and assembled at RMA by the Army. The Army chemical agent manufacturing operation ended in late 1969.

Shell Chemical Company (Shell) assumed chemical manufacturing operations in 1952, which they operated for the production of herbicides and organochlorine pesticides (e.g. aldrin, dieldrin, endrin) until 1982.

The waste disposal practices at RMA resulted in extensive shallow ground water contamination. The problem was initially limited to onpost surface and near surface soil and water. Over the years, some of the wastes percolated down through the soils, carrying the contaminants into the shallow ground water table (alluvial aquifer) and offpost. The primary shallow (alluvial) ground water contaminant identified down gradient from RMA operations is Diisopropylmethylphosphonate (DIMP).

The only current mission of RMA is contamination cleanup. There are currently no operational missions. This cleanup is expected to last well into the next decade.

3.0 REGIONAL HYDROGEOLOGY

Ground water resources within the inventory area (Figure 2) consist of the alluvial aquifer and three bedrock aquifers (Figure 3). Surficial, unconsolidated alluvial and eolian deposits (Figure 4) locally yield sufficient quantities of water to be considered aquifers (ESE, 1986). The alluvial aquifer is the primary source of irrigation water in the area and is the primary water source for the South Adams County Water & Sanitation District (SACWSD). The alluvial aquifer consists of fine sands, clay, and silt deposits near the ground surface (ESE and HLA, 1988). The overall permeability of the alluvial deposits is enhanced by the coarse nature of the materials. This is especially true in areas of paleochannels where the bulk of the material consists of gravels, cobbles, and boulders. These areas serve as the major transport pathways for RMA-related

contaminants via migration in the shallow ground water (alluvial aquifer) within the inventory area (ESE, 1986). One of these channels is believed to occur along the First Creek drainage (Figure 4).

The bedrock aquifers are listed below in order of depth from shallow (closest to ground surface) to deep:

- Denver Formation
- Arapahoe Formation, and
- Laramie/Fox Hill Sandstone.

The Denver Formation is a minor water supply in the area, compared with the other bedrock aquifers. Portions of the Denver Formation are present in the offpost area north of the North Boundary System (NBS), and these zones are predicted to subcrop (Figure 5) just north of RMA northern boundary (South of 104th Avenue; ESE and HLA, 1988). A 50-to-100-foot thick clayshale with the updip direction to the northwest provides hydraulic separation between the Denver and Arapahoe Formations (Romero and Ward, 1981). In areas where the Denver Formation subcrops, the alluvial and upper Denver aquifers may be hydraulically connected.

The Arapahoe Formation is a primary source of drinking and domestic-use water for private wells in the inventory area. The Arapahoe Formation underlies the Denver Formation (Figure 3) in the inventory area, with the top of the formation estimated to be about 250 to 300 foot below the ground surface at RMA northern boundary (ESE and HLA, 1988, and Romero and Ward, 1981).

The Laramie and Fox Hill Sandstone units are not widely used aquifers within the inventory area and are thus not discussed in detail. The Fox Hill Sandstone generally occurs at depths greater than 1,000 feet below the ground surface in the inventory area.

Semi-permeable confining layers serve to restrict flow between the alluvial, Denver, and Arapahoe aquifers, and partially isolate one aquifer from another. Interconnections and thus vertical ground water flow between aquifer-confining layers can be provided by improperly constructed or improperly sealed ground water wells and/or by wells with damaged or corroded casing (pipe).

4.0 PURPOSE AND OBJECTIVE OF WORK PLAN

The major objectives of this Work Plan are:

- To update and augment (both computer database and hard copy files), the TCHD 1988-1989 well survey data (TCHD, 1990). This includes well locations,

well uses, and user data within the expanded inventory area boundaries.

- To update and augment currently available water quality information from private water supplies, which will allow for a more detailed determination of the area impacted by RMA-related chemicals and to provide data for regulatory or risk assessment purposes and to refine the existing contaminant migrant pathway data. Individual well test results are also to be interpreted for and reported to well owners.

- To respond in a timely manner to requests/concerns by the public and to coordinate with and disseminate information to the public concerning RMA-related matters and public health.

- To determine to what extent residents are being exposed to RMA-related chemicals via consumption of water from private domestic-use wells in the inventory area (see Figure 2). To provide information for a risk assessment related to the presence of RMA-related chemicals in domestic-use wells. Risk assessment is not part of this work, but will be facilitated by the data obtained in this program.

- To establish a new computer system (database) that will aid in the accessibility (by numerous parties) of the demographic and field chemistry survey data, and coordination of historical and current efforts by other agencies and contractors. The system will be user friendly and include numerous well aliases to allow coordination with other agency's well designations.

5.0 SCOPE OF WORK

The scope of work for the Work Plan is divided into the following three major tasks:

TASK 1: Sampling of private wells and laboratory analysis for RMA-related and additional chemical analytes (Table 1),

TASK 2: Computer database,

TASK 2A: Update and augmentation of TCHD 1988-1989 well survey with additional expansion of the previous survey area to include the offpost area between East 80th Avenue and East 96th Avenue (Figure 2 -not previously surveyed by TCHD), and

TASK 2B: Establishment of a new computer database system for coordination of ongoing and historical data on wells in the inventory area as performed by TCHD and other agencies and contractors.

TASK 3: Public inquiry response, education and information dissemination; response to public agency and contractor requests; and interface and coordination with other agencies and contractors concerning RMA related programs.

These tasks are discussed in detail in the sections below.

6.0 TASK 1: Sampling of Private Wells

Private wells shall be sampled using tap sample methods in accordance with the Chemical Quality Assurance Plan, Version 1.0 (RMA, 1989), Section 5.0. Split samples shall be taken for the Army, Shell Oil Company, The U.S. Environmental Protection Agency (EPA), and Colorado Department of Health (CDH), as requested. The proposed sampling program is briefly described as quarterly sampling of about 25 different private, domestic-use wells (or other types of wells, as identified) in the inventory area for laboratory analysis of the chemical parameters listed in Table 1.

Well selection, prioritization, and sampling frequency are discussed in Section 6.1. Field procedures, Quality Assurance/Quality Control procedures, sample shipment and laboratory analysis program for this Work Plan are discussed in the following sections. Reporting of test results is discussed in Section 11.0.

6.1 Well Selection Criteria, Prioritization and Sampling Frequency

The well selection criteria, prioritization and sampling frequency defined in this Work Plan are based upon the most efficient network of sampling that would meet the objectives of the program. These objectives are discussed in detail in Section 4.0. The chemical analytes to be monitored are discussed in Section 6.5 and are listed in Table 1. In summary, the major objective of this sampling program is to provide ground water quality monitoring for domestic-use wells (via tap sampling) in the area of RMA-related contamination on a varied frequency as described in Sections 6.1.1 and 6.1.2 and as summarized in Table 3. This data may then be used for regulatory or risk assessment purposes, and will be interpreted for and reported to the well owners. A second objective is to sample selected "other use" (e.g., irrigation, stock use) wells in the area of RMA-related contamination in order to provide additional

risk assessment and/or contaminant migration pathway data on an as needed basis.

6.1.1 Prioritization of Wells

The inventory area is designated as the area where additional information is needed concerning RMA-related contaminant distribution. The inventory area is divided into three primary sub-areas (Figure 2) in accordance with the expected concentrations of RMA-related contaminants in the shallow ground water (based on the test results of previous investigations). The private wells are ranked into four priority groups (Table 2) for sampling, according to a combination of their geographic location, use, depth and other factors as follows:

- Location (see sub-areas in Figure 2, and well locations in Figures 6 and 7). The well location sub-areas are defined based on the probable ranges of RMA-related chemicals in the shallow ground water as discussed below:
  - Areas Ia and Ib may have RMA-related chemicals at levels above current health guidelines in the shallow ground water.
  - Area II may have RMA-related chemicals at detectable levels in the shallow ground water, but these levels are expected to be below current health criteria.
  - Areas III, IVa and IVb are not expected to have RMA-related chemicals in the ground above the laboratory test detection limits (see Laboratory Analysis Program, Section 6.5.1).
- Use (e.g., domestic/drinking versus irrigation or or other uses),
- Depth (e.g., shallow/questionable/unkown versus deep), and,
- Other (e.g., past test results, request from the resident or from the Army).

The wells are ranked into four priority groups (see Table 2) using the above factors, as defined below:

- Priority 1 : domestic-use wells in Areas Ia and Ib (Figure 2),
- Priority 2 : domestic-use wells in Area II (Figure 2),

- Priority 3 : domestic-use wells in Areas III, IVa and IVb (Figure 2), and

- Priority 4 : non-domestic-use wells in any of the sub-areas within the inventory area.

Wells that are not currently private wells (e.g. public wells, monitoring wells) and wells not currently in-use are not listed in Table 2 for proposed sampling.

6.1.2 Well Sampling Frequency

Well sampling frequencies are defined by the following logic (see Table 3):

- Priority 1 wells (Table 2) shall be sampled in first order (at a rate of about 25 wells per quarter) with followup monitoring of shallow, domestic wells on an annual basis.

- Priority 2 wells (Table 2) shall be sampled after all Priority 1 wells have been sampled once. Priority 2 wells are to be monitored at least once in a two-year sampling period, are located in Area II (Figure 2), and are shallow or deep domestic-use wells.

- Priority 3 wells (Table 2) shall be sampled after Priority 1 and 2 wells have been sampled once. Selected Priority 3 wells are to be monitored once in a two-year sampling period, are located in Areas III, IVa, and IVb (Figure 2), and may be shallow or deep domestic-use wells.

- Priority 4 wells (Table 2) shall be sampled, on an "as deemed necessary" basis, throughout the sampling program period and are nondomestic-use wells (primarily shallow wells) in any of the sub-areas of the inventory area (Figure 2). These wells shall be sampled if additional ground water quality data is needed to assess distribution and extent of RMA-related contamination in the inventory area or if risk assessment data is needed for irrigation or stock use wells.

About 25 different wells shall be sampled each quarter over a two-year sampling period, as per the above defined prioritization plan until all Priority 1 and 2 wells are monitored at least once. Selected Priority 3 and 4 wells will then be sampled. A total of about 200 wells are expected to be sampled (over 8 quarters). Subsequent sampling frequencies and well prioritizations shall be defined, after the initial well sampling results are assessed. Wells shall be ranked for subsequent sampling based on previous test results, location, use, depth, or other factors not foreseen.

Wells with no detectable RMA-related chemicals may not be resampled as frequently as wells that have detectable amounts of RMA-related chemicals.

Frequent hardness and specific conductance measurements (see Table 3) will be used to monitor the water character between samplings for laboratory analyses (see Table 3).

6.2 Field Procedures and Documentation

For greater consistency of test results to facilitate comparison with the other ongoing onpost and offpost ground water sampling programs (Stoller, et. al., 1989 and HLA , 1989), field and documentation procedures for sampling will generally follow the sampling and documentation procedures outlined in Sections 6.0-8.0, 13.0, 14.0 and 15.0 of the Offpost Interim Response Action and Remedial Investigation/Feasibility Study Draft Final Field Operations Procedures Plan , prepared by Harding Lawson Associates (HLA) dated August 1989 (RI/FS Plan, HLA, 1989). The TCHD Ground Water Monitoring Field Operating Procedures Plan are provided in Attachment B. Example field forms for documentation of field data are also shown in Attachment B. Field procedures will differ somewhat from the referenced (HLA) plan in that the well samples for this Work Plan will generally be obtained from tap (spigot) sources, rather than by using bailers or pumps.

The field test parameters at the time of well sampling shall be specific conductance (automatic temperature correction), alkalinity, hardness, temperature and pH. Because tap samples are to be employed, dissolved oxygen field readings are not deemed appropriate and will not be performed. A minimum of five replicate field parameter measurements (performed about every 9 minutes during purging) shall be performed on each well sample, or until measurements have stabilized. The wells shall be purged for approximately 45 minutes, with owner's permission, prior to sampling. Tap samples shall be obtained prior to pressure or storage tanks, where possible. Samples for laboratory analysis shall not be collected until field parameter readings have stabilized. Samples for metal fraction analytes shall be filtered in the field using 0.45 micron cellulose acetate filters. All sample preservation procedures shall be those described in the Field Operating Procedures Plan (Attachment B). A summary of the sampling and field procedures are shown in Table 4. Field Health and Safety procedures are discussed in Section 9.0 and the Health and Safety Plan (Attachment A).

6.3 Sampling QA/QC Procedures

Quality Assurance/Quality Control (QA/QC) procedures for sampling of the wells shall be in accordance with the Chemical Quality Assurance Plan , Version 1.0, July 1989 (QA Plan-RMA, 1989). Sampling containers, sampling procedures and control samples shall be conducted by TCHD in accordance with Section 5.0 of the QA Plan (RMA, 1989). The following QA samples shall be included at a rate of 5 percent of the well samples collected (a minimum of one field blank and one trip blank submitted to laboratory with approximately each 20 well samples):

- One Field Blank (using analyte-free water), and
- One Trip Blank (using laboratory provided analyte-free water).

Field blank samples (for volatile analyses only) shall be taken in the field using rinse water during the sampling to monitor potential contamination during the sampling process. Trip blank samples shall be laboratory provided rinse water transported in laboratory bottles that shall be uncapped in the field, and then returned with the well samples to monitor potential contamination of sample bottles and/or potential contamination during sampling, transportation and shipment of the samples. Because no sampling equipment is to be employed (tap sampling shall be performed), equipment rinse blanks are not deemed necessary.

In addition, duplicate/replicate samples (well samples divided into two portions) shall be collected on randomly selected wells to monitor the consistency of the sampling procedures and shall be sampled at a rate of 10 percent of the total samples collected.

Field instrument calibrations and maintenance shall be performed at least daily and in accordance with manufacturer's specifications and Section 8.0 of the QA Plan (RMA, 1989). Valid and properly formatted QA documentation of the field instrument calibration procedures shall be performed in a log book for instruments as per Section 9.0 of the QA Plan. Sample analyses and laboratory QA/QC will be conducted by a contract laboratory (to the Army) in accordance with Section 6.0 of the QA Plan (RMA, 1989).

6.4 Sample Shipment/Custody Tracking

Samples shall be shipped directly to the laboratory contracted by the Army on the same day they are collected. Sample bottle labels shall be completed prior to sample collection. After collection, sample bottles shall be wrapped in bubble pack and placed in coolers with frozen cool packs (blue ice) for shipment at 4

degrees Celsius to the laboratory. Proper chain-of custody documents shall be completed and shipped in each sample cooler. Coolers shall be sealed with evidence tape and initialed before shipping via overnight delivery service. Sample custody, shipment preparation, and tracking procedures will generally follow field procedures as outlined in Section 13.0, RI/FS Plan (HLA, 1989). The field sampler shall complete chain-of-custody records (in duplicate) at time of shipment, (relinquishing samples). Hazardous Substance Notification Labels shall be attached to the coolers.

6.5 Laboratory Analysis Program

The objective of the laboratory analysis program is to provide reliable ground water data that is as comparable as possible with other onpost and offpost ground water sampling programs (Stoller, et. al., 1989 and HLA, 1989). The collected ground water samples shall initially be analyzed for a selected list of chemical parameters as discussed in Section 6.5.1 (Table 1), in order to achieve a quantitative determination of water quality. A reduced list of chemical parameters may be employed for subsequent samples, based upon a review of the results from the initial testing, as discussed in Section 6.5.1. The analytical program also includes semi-quantitative analysis of selected samples as discussed in Section 6.5.2.

6.5.1 Analytical Parameters

The ground water samples which are to be collected in Areas Ia, Ib, II, III IVa and IVb (Figure 2) during sampling events outlined in this Work Plan shall be initially analyzed for the parameters listed in Table 1. The list of analytical parameters to be used is consistent with the analytes of the other onpost and offpost ground water sampling programs (Stoller, et. al., 1989 and HLA, 1989).

This analyte list may be modified or reduced for future sampling events based upon interpretation and evaluation of data collected during the initial monitoring. For example, deep wells used for domestic purposes and located in Areas Ia, Ib or II (Figure 2) that are initially tested as having no detectable RMA-related chemicals (e.g., DIMP) shall be subsequently monitored every 6 months (see Table 3) for field parameters of nitrates, fluoride, hardness and specific conductance. If the field parameters do not indicate a significant (over 10 percent) change in field parameter readings, full analyte testing (Table 1) may not be deemed necessary on a routine basis. Such wells may then be recommended for analysis of a few key compounds (e.g. DIMP, DBCP), for subsequent monitoring.

The methodologies and detection limits for analysis of target analytes are as specified by PMRMA-certified analytical methods. Specific analytical methods are discussed in detail in the Comprehensive Monitoring Program (CMP) Analytical Procedures Manual.

The technical quality of the data generated in this program shall be assured by documenting all of the analytical procedures and by requiring all data to exceed minimum analysis method requirements with respect to instrument calibration. Sample preparation, materials shipping, handling and chain-of-custody procedures shall follow the protocols outlined in the QA Plan (RMA, 1989).

6.5.2 GC/MS Analysis

The laboratory analysis program shall include a semi-quantitative analysis of selected ground water samples by the GC/MS analytical technique. This technique shall provide confirmation of target analytes that can be detected by gas chromatography (GC). In addition, the GC/MS analysis shall be used to indicate the presence of nontarget analytes. Consistent with prior practice of other onpost and offpost ground water sampling programs (Stoller, et. al., 1989 and HLA, 1989) where nontarget analytes are repeatedly detected at elevated levels, action shall be taken to identify the compounds and evaluate them for incorporation into the target analyte parameters.

GC/MS analysis shall be performed on approximately 10 percent of the total samples collected from any of the quarterly sampling events for Areas Ia, Ib, and II (Figure 2). A random selection of 10 percent of the total annual well samples shall be analyzed using GC/MS. As initial data are evaluated, the percent of wells to be analyzed using GC/MS may change for subsequent sampling events.

7.0 TASK 2: Computer Database

The previous well survey data shall be updated and augmented, and ongoing field chemistry tests performed for the wells in the inventory area as discussed in Section 7.1. This data shall be entered into a new computer database. Additional data shall be included in this new database to aid in coordination of well data from ongoing and historical programs as performed by other agencies and their contractors. The new database is discussed in detail in Section 7.2.

7.1 TASK 2A: Update and Augmentation of Previous Well Survey

The previous well survey data (TCHD, 1990) shall be updated and augmented. In addition, ongoing field

chemistry tests will be performed for the wells in the survey inventory area. The survey tasks are listed in Section 7.1.1. the ongoing field chemistry tests for wells in the inventory area are discussed in Section 7.1.2.

7.1.1 Survey Update and Augmentation Tasks .

The following listed tasks shall be performed as followup to the initial offpost private well survey (TCHD, 1990):

Contact property and well owners not previously surveyed (e.g., not previously able to contact and those located in expanded survey area between East 80th and East 96th Avenues) to obtain information and field testing data (hardness, specific conductance, nitrate and fluoride), if possible.

Perform field tests (hardness, specific conductance, nitrate and fluoride) for those wells for which data was included in the initial survey but that were not field tested as part of that program (e.g., irrigation wells that were closed for the winter during the previous survey).

Perform ongoing, periodic field testing (hardness specific conductance, nitrate and fluoride) for all deep wells in the survey area (i.e., those wells previously examined and determined to have deep aquifer characteristics) on at least a biennial (once in a two-year period) basis to assess water quality changes (if any). Deep wells south of O'Brian Canal and Burlington Ditch will be field tested for hardness and specific conductance at least semi-annually (see Table 3). Survey information (e.g., owner, resident, etc.) will be updated during this process.

Develop section maps with well locations by field-truthing preliminarily plotted well locations (scaled from map section line or field paced from section lines) on aerial photographs/maps with a scale of 1" = 200'.

Review quarterly new septic system permit and drilling permit applications to identify potential new well installations within the survey area and provide information on new wells (as they occur).

Interpret and distribute well survey field test results (hardness, specific conductance, nitrate and fluoride) to individual well owners.

Continue to update the computer database with new information collected regarding the well survey and

any new field test results completed for wells (see Section 7.0).

Revise and submit to the Army the updated and expanded well survey on an annual basis or as needed, in a brief letter report with an attached computer printout and floppy disk.

7.1.2 Ongoing Field Chemistry Tests

Relatively homogeneous aquifers have characteristic ranges of hardness and conductivity. Due to these characteristic "fingerprint" water quality values, aquifers can be differentiated from one another on a qualitative basis by the hardness and conductivity measurements.

The field chemistry tests to be performed for the Work Plan were selected in order to most easily differentiate between the waters of the predominant aquifers within the inventory area. The ongoing field tests shall consist of physical examination of visual appearance, as well as hardness and specific conductance, and notation of taste and odor description as described by well owner/resident. Nitrate and fluoride measurements will also be made.

Field parameters to be tested as part of the ongoing survey will include nitrate and fluoride in order to develop a database by which well quality (e.g., deep or shallow) classification can be confirmed, in addition to using hardness and specific conductance readings for well classifications. Public health concerns arising from elevated nitrate or fluoride reading will also be discussed with the well owners.

Field instruments shall be calibrated at least once daily to increase the accuracy of the measurements. Wells shall be purged until hardness and specific conductance measurements have stabilized prior to recording the measurements. Repeated measurements shall be performed in an effort to characterize the water in the aquifer recharge of the well rather than the standing water in the well casing or water distribution/piping system.

Measurements of hardness in parts per million (ppm) and specific conductance in micromhos per centimeter (umhos/cm) shall be performed as per the techniques described in the methods 309B and 205, respectively, Standard Methods for the Examination of Water and Wastewater , 14th edition (Standard Methods, 1975). The accuracy of the measurements for both hardness and specific conductance shall be well within the values required to differentiate between the alluvial and deeper aquifers.

Using methodology similar to that employed by ESE for the previously conducted private well investigations (ESE, 1985, 1986 and 1987), hardness and specific conductance measurements shall be used to classifiy the wells using the following criteria:

Classifications of "alluvial aquifer" water shall be based upon hardness readings in excess of 200 ppm and conductivity readings above 850 umhos/cm. These wells are expected to generally be less than 100 feet deep. The aquifer depth from the ground surface varies somewhat over the inventory area, depending upon proximity to the South Platte River, localized topography, and other geologic features.

Classifications of Arapahoe Formation waters shall be based upon hardness readings below 150 ppm and conductivity readings below 640 umhos/cm.

The Fox Hill aquifer hardness readings are expected to be below 20 ppm, with specific conductance readings between 750 and 960 umhos/cm. Few wells within the TCHD study area are believed to be Fox Hill wells.

Wells shall be defined as "Questionable" wells based on hardness and specific conductance readings between the sets of ranges, and/or those having alluvial-type readings with owner-reported depths greater than 150 feet. These wells may have erroneously reported depths, and/or may be mixed aquifer waters, such as improperly sealed wells or wells with damaged casings. Denver wells may also be in this category. Denver wells are generally limited to a few areas south of East 104th Avenue (see Figure 5).

Wells without sufficient available data to allow assessment of the aquifer shall be defined as "Unknown Aquifer" and the computer aquifer classification category is "Unknown". Wells classified as "Unknown Aquifer" will include wells for which no hardness and specific conductance measurements can be made, for which field observations of the well construction type will not allow classification, and for which no definitive available depth information can be obtained, either through well records or discussion with the well owner.

Wells classified as "Deteriorated" and "Sealed/Capped" wells shall be defined as wells for which the well-owner reported a collapsed or cracked well casing and/or reported the well as sealed or capped. "Questionable" wells (as previously discussed) shall not be included in this category, although some of the "Questionable" wells

may actually have casing problems.

7.2 TASK 2B: Establishment of a New Computer Database for Coordination of Data

A new computer database was developed to allow coordination of data from ongoing and historical well investigations as performed by other agencies and their contractors. Well number aliases and location coordinates shall be incorporated into the new database. To accomplish the TASK 2A and TASK 2B computer needs, the well survey questionaire shall include the following information to be entered on computer file:

PROPERTY INFORMATION :

TCHD PROPERTY ID NUMBER :	Arbitrary sequential number assigned to each property as entered on computer file.
ASSESSOR MAP ID:	Adams County Tax Assessor's Office (ACTAO) map number, which includes section number and ACTAO property number.
PROPERTY ADDRESS:	Physical location of property.
OWNERSHIP/DATES:	Current and past property owner(s) as listed in ACTAO records and effective ownership date. (Possible field of five).
OWNER'S MAILING ADDRESS:	Mailing address of property-owner.
OWNER'S HOME PHONE:	Home phone of property-owner.
OWNER'S WORK PHONE:	Work phone of property-owner.
NUMBER OF WELLS ON PROPERTY:	Number of wells (1,2,3).
DATE SURVEYED:	Date information was originally obtained on property and/or well(s).
DATE OF SUBSEQUENT INQUIRIES FROM RESIDENT AND FOLLOWUP RESPONSE DATES:	Dates additional information was requested and Tri-County Health Department response date.
RESIDENTS INFORMATION :	(Possible field of five)
MAILING ADDRESS:	Mailing address of resident (may have more than one family

	unit at each address).
HOME PHONE:	Home phone of each residence at property.
WORK PHONE:	Work phone of head-of-household of residence.
NAME:	To be obtained for each resident at property.
DATE OF BIRTH (DOB):	Date of birth of each resident.
SEX:	Sex of each resident.
% OF DIET VEGETABLES:	Percent of diet from homegrown vegetables (averaged over whole year) for each resident.
% OF DIET LIVESTOCK:	Percent of diet from homegrown livestock (e.g., beef, pork, poultry, eggs) for each resident.
DATES OF RESIDENCE:	Period of time (date of move-in to date of move-out or present date) for each resident.
LOCAL HUNTING:	Yes or no as to hunting on property or within RMA vicinity and type of game hunted (e.g. doves, ducks, pheasants, rabbits, geese, deer, squirrels).
DRINKING WATER SOURCE:	Source of drinking water for residence at property (e.g., community supply, well, bottled, other). If stated as none: no drinking water source (e.g., irrigation water only, or no well).
COMMUNITY SUPPLY TAP PRESENT:	Yes or no. If yes, is it used, yes or no, the name of the supply and address, CDH PWSID, number of taps, or number of people served.
WELL SOURCE:	Yes or no; if yes, list Well ID Number.
BOTTLED SOURCE:	Source (brand) of bottled water, dates of use from when to present.

MULTI-USER WELL SOURCE:	Well ID Number.
OTHER SOURCE:	Field for other sources of water.
TREATED:	Yes or no as to any treatment of water for each residence at property.
TREATMENT TYPE:	Listing of type of water treatment for each residence at property (e.g., softeners, filter, reverse osmosis, distillation, chlorination or other).
WELL INFORMATION :	(Possible field of five)
WELL CLASSIFICATION NUMBER:	Classification number 1-4 based on priority rating (see classification system in field worksheet).
TOWNSHIP-RANGE-SECTION NUMBER AND DISTANCE (IN FEET) FROM NEAREST TWO SECTION LINES:	Description of each well location using township-range-section and feet (paced or scaled off map) from two closest section lines (e.g., N,S,E, or W).
STATE WELL PERMIT RECORD NUMBER:	State permit record number for each well on property, if recorded with State of Colorado Water Resources Engineer Office.
DATE CONSTRUCTED:	Date of well construction as per state drill permit records/ drill log.
360 DEGREE PROGRAM ID NUMBER:	Roman numeral or letter designation for 360 Degree Monitoring Program wells.
SHELL WELL ID NUMBER:	Number or letter as assigned by Shell.
ARMY WELL ID NUMBER:	Number or letter as assigned by Army.
ESE WELL ID NUMBER:	Environmental Science and Engineering, Inc. (ESE) well number designation from previous investigations from 1985 through 1989. (Possible field of five).

OTHER WELL ID NUMBER:	Other number or letter assigned and field for comments.
CONSTRUCTION TYPE:	Method of well construction (e.g., drilled, hand-dug, unknown, etc.) and field for comments.
CASING TYPE:	Steel, PVC, concrete, unknown or other.
AQUIFER:	Designation of aquifer based on best available depth information (see below) and/or field measurements (specific conductance and hardness), such as Alluvial, Arapahoe, Fox Hill Questionable or Unknown. If the entry is "Unknown", the aquifer could not be assessed and is unknown. Most wells can be classified based on field measurements even if the depth was unknown. Also a field for comments.
DEPTH:	Total depth of well in feet, based on best available source (see below).
SOURCE OF DEPTH:	Reference source of well depth, such as from drill log, owner-reported, state permit records, field measured, bedrock data map, etc.
EVER SAMPLED/DATE/ SAMPLER/RESULTS:	Yes or no, as to whether well was previously sampled for RMA chemicals, nitrates, etc.; date sampled; sampler designation (e.g., Army, ESE, CDH, Shell, etc.); and result and/or file reference where results can be obtained. (Possible field of five).
REQUEST SAMPLED/ TEST REQUESTED/ RESULT/DATE:	Yes or no as to requested sampling for (CDH) laboratory testing and which test was requested/done (e.g., RMA-related analytes, bacteria, etc.); numerical value of test results; and date tested.
CONDUCTANCE/DATE:	Specific conductance reading in

	umhos/cm as measured in field and date of reading. (Possible field of five).
HARDNESS/DATE:	Hardness reading in ppm as measured reading. (Possible field of five).
FLUORIDE/DATE:	Fluoride reading in ppm as measured in field and date of reading. (Possible field of five).
NITRATE/DATE:	Nitrate reading in ppm as measured in field and date of reading. (Possible field of five).
RESULTS SENT/DATE:	Yes or no as to whether owner and/or resident was sent test results and date sent.
PHYSICAL EXAMINATION:	Comments for taste, odor, visual appearance of water.
CASING STICK-UP:	Distance in feet from top of casing to ground surface.
MEASURED DEPTH OF WELL:	Distance in feet from bottom of well to top of casing.
DEPTH IN FEET CORRECTED TO GROUND SURFACE:	Depth of well in feet from ground surface to bottom of well (corrected for casing stick-up).
STATIC WATER LEVEL:	Water level in feet of water to top of casing.
USES:	Uses of each well (e.g., community supply, drinking, domestic, crop irrigation, livestock, non-food irrigation, none or other).
STATUS OF WELL:	Status of well (e.g., in use, unused, sealed, seasonal, dry, etc.).
WELLHEAD LOCATION DESCRIPTION:	Comment field for location of sampling point.
COMMENTS:	Comment field for general comments.

WEATHER CONDITIONS:	Comment field for weather (e.g., rain within 24 hours) at time of sampling and interview.
PERSON INTERVIEWED/DATE:	Name of person interviewed and date of interview.
TCHD EXAMINER'S INITIALS:	Initials of TCHD personnel doing interview.

8.0 TASK 3: Public Response, Education and Information Dissemination :

The proposed public education and information dissemination efforts to be conducted by TCHD are listed below:

Obtain property access and owner permission for well sampling, or other activities where access to private property may be required.

Distribution of information to the public to address questions on the following issues (and other issues as they arise) related to RMA: health concerns, RMA history, cleanup actions and status, and offpost RMA-related contamination information.

Sampling of selected wells not specifically included in the inventory area, as requested by the Army. Split samples will be provided to other agencies as requested.

Odor complaint response during the course of RMA onpost and offpost cleanup activities. These actions may include an initial field visit to verify the odor complaint, and followup field visits to confirm odor.

Offpost air sampling and analysis for RMA-related chemicals as requested by the Army. This action shall also include interpretation and distribution of analytical results.

Coordination of the ongoing and historical well monitoring programs by TCHD and other agencies and contractors. TCHD shall continue to respond to public agency and contractor information requests concerning RMA.

Toxicological and occupational residential health-related investigations and consultations, as requested by the Army to address RMA-related contamination concerns.

Consultations concerning well disinfection/

chlorination and distribution of related literature.

Well construction, maintenance, and repair consultations.

Sampling for CDH laboratory analysis of well water for routine parameters such as fecal coliform bacteria, etc., as requested by the well users,

Consultations and recommendation of precautionary measures for well owners with naturally elevated levels of nitrates, fluoride, and/or concerning contaminants from other sources (not RMA-related).

Sampling and/or split sampling of selected wells for laboratory analysis of RMA-related chemicals for other agencies, as approved by the Army.

Coordination with local media for dissemination of RMA-related public health information.

Interpretation and discussion of individual well survey results, and/or previously performed laboratory test results (if any) for RMA-related chemicals with individual well owners, if requested.

9.0 HEALTH AND SAFETY PROCEDURES

A Health and Safety Plan developed for the field activities in the TCHD inventory area is provided in Attachment A. This plan was developed in accordance with appropriate OSHA regulations (i.e., 29 CFR 1910.134 and 29 CFR 1910.120). Field personnel shall be trained as specified in 29 CFR 1910.120(e). This includes the initial 40-hour basic health and safety training required by the OSHA regulations, even though minimal or no contact with hazardous materials is expected to occur.

10.0 DATA MANAGEMENT

Data management procedures shall be performed in accordance with the QA Plan, Section 9.0 (RMA, 1989). Field data documentation procedures are also addressed in Section 6.2 of this text.

The contract laboratory will perform data validation and all laboratory data QA will be the responsibility of the laboratory and the Army. The Army (or contractors as specified by Army) will also be responsible for laboratory audits and data review/acceptance procedures (validation).

Using the chemical results from the ground water

analyses in combination with past chemical data, the general extent to which RMA-related contamination exists in the area ground water shall be assessed.

All well inventory updates shall be entered into a computer database maintained by TCHD. All task-related computer files shall be copied onto floppy disks as they are updated (at least annually). Copies of the floppy disks shall be transmitted to the Army as the files are updated (or more frequently upon Army request). A paper copy of some of the key computer files may also be required for submittal to the Army on a periodic basis.

A file cabinet (or series of cabinets) shall be dedicated solely for this project for the storage of hard copies of computer data, field data sheets, reports, and project files among other project related material.

11.0 DATA ASSESSMENT AND REPORTING

Information generated by this Work Plan shall be presented on an as needed basis in technical review meetings with the Army and other interested parties and submitted in an annual computer database update (or more frequently as requested by the Army). The following items shall be reported:

- discussions of all work performed during the previous quarter,
- compilation of field, laboratory, and office data (including computer database) developed under the program,
- the results of interpretive efforts,
- conclusions drawn during the program,
- recommendations for program changes for succeeding monitoring events,
- recommended modifications to the monitoring system, and
- recommended changes in the operation or monitoring of specific remedial actions.

11.1 Presentation of Ground Water Data

Both tabular and graphical presentations of ground water data shall be provided. Tabular presentations shall, at a minimum, include:

- a summary of ground water chemistry results (field and laboratory) by sampling event, and

- a discussion of any recommended alterations in sampling locations, frequency, analytical parameters, equipment, methodology, and the need for other future out-of-scope activities.

Graphical presentations shall include:

- contaminant point plot maps (e.g., plotted numerical values of RMA-related chemicals detected), for DIMP or other target analytes in domestic-use wells, and

- section maps indicating any revisions in preliminarily plotted well locations (field-truthed well location maps).

11.2 Reporting Test Results to Well Owners

Prior to sampling, well owners will be requested to sign a release (see Attachment B) acknowledging an understanding of the purposes for the collection of the well information and the potential uses for the data. As they become available, the test results (laboratory and field) for private wells shall be reviewed, interpreted and distributed by TCHD to the private well owners and residents via a letter report, with Army coordination and input. Requests for specific wells test results, requested by anyone other than the well owner or well user, will be routed to the Army.

12.0 PROJECT SCHEDULE

The proposed schedule or implementation of the Work Plan tasks is presented in Table 5.

13.0 REFERENCES

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Tri-County Health Department (TCHD), 1990. Final Report, Rocky Mountain Arsenal Offpost Private Well Inventory and Information Survey, June, 1990.

U.S. Army, Program Manager for Rocky Mountain Arsenal Contamination Cleanup, (RMA) 1989. Rocky Mountain Arsenal Chemical Quality Assurance Plan, Version 1.0, July 1989.

TABLES

TABLE 1

LIST OF ANALYTES

Organochlorine Pesticide Method

- Aldrin
- Endrin
- Dieldrin
- Isodrin
- Hexachlorocyclopentadiene
- p,p'-DDE
- p,p'-DDT

Volatile Organohalogen Method

- Chlorobenzene
- Chloroform
- Carbon Tetrachloride
- 1,2-Dichloroethene (cis-and trans-)
- Trichloroethene
- 1,1 Dichloroethene
- 1,1 Dichloroethane
- 1,2 Dichloroethane
- 1,1,1 Trichloroethane
- 1,1,2 Trichloroethane
- Methylene Chloride
- Tetrachloroethene
- Vinyl Chloride

Organosulfur Compound Method

- P-Chlorophenylmethylsulfone
- P-Chlorophenylmethylsulfoxide
- P-Chlorophenylmethylsulfide
- 1,4-Dithiane
- 1,4-Oxithiane
- Dimethyldisulfide
- Benzothiazole

Organophosphorus Compound Method

- Parathion

Volatile Aromatic Method

- Toluene
- Benzene
- Xylene (m-)
- Ethylbenzene
- Xylene (o,p)

DCPD/MIBK Method

- Dicyclopentadiene
- Methylisobutyl Ketone

Phosponate Method

- Diisopropylmethylphosphonate (DIMP)
- Dimethylmethylphosphonate (DMMP)

DBCP Method

- Dibromochloropropane

Metals

- Mercury
- Arsenic
- Cadmium
- Chromium
- Copper
- Lead
- Zinc

Cations

- Potassium
- Calcium
- Magnesium
- Sodium

Anions

- Chloride
- Fluoride
- Sulfate
- Nitrate + Nitrite
- Alkalinity

Acid Extractables*

- Phenols (EPA Method 8270)

Cyanide Method

- Cyanide

GC/MS *

- Base
- Neutral
- Acid

* 10% of wells sampled annually in Areas Ia, Ib, II and III.

TABLE 2

WELL PRIORITIZATION LIST

Priority 1 Wells (Domestic-use, all depths, Areas 1a and 1b).

Area 1a

Shallow*			Deep		
395A	1144A	416A	716A	705A	706A
1115A			404A	405A	412A
			403A	721A	1162A
			415A	413A	1141A
			410A	435A	404B
			411A	414A	

Area 1b

Shallow*			Deep	
1323A	1326A	641A	297A	1325A

Priority 2 Wells (Domestic-use, all depths, Area II)

Shallow			Deep		
1173A	953A	986A	595A	1249A	580A
550A	602A	377A	928A	299A	979A
546A	542A	583A	598A	930A	636A
1070A	1111A	332A	489A	596A	337A
332C	555C	594A	552A	486A	601A
952A	909A	1172A	931A	617A	628B
332B	1185A	332D	581A	929A	361A
592A	540A	588A	490A	985A	911A
332D	395A	340B	959A	359A	956A
485A	341A	603A	912A	368A	600A
538A	954A	941A	983A	960A	913A
551A	373A	342A	1190A	1233A	866A
338A	981A	976A	397A	1060A	606A
590A	561A	948A	1242A	588A	990A
331A	608A	586B	975A	1065A	545A
578B	940A	616A	571A	1302A	544B
372A	977A	609A	927A	1167A	339A
1234A	396A	961A	549A	555A	607A
330A	1305A	613A	906A	1189A	557A
365A	582A	1252A	1216A	1219A	556A
578A	914A	849A	862A	1178A	1171A
			867A	376A	589A
			869A	493A	614A
			843A	1186A	610A
			925A	343A	1266A
			926A	494A	611A
			864A	328A	984A
			844A	1324A	

TABLE 2

WELL PRIORITIZATION LIST

(Continued - page 2)

Priority 3 Wells (Domestic-use all depth - Area III, IVa & b)

Area III

Shallow*			Deep		
1172A	976A	1255A	465A	845A	840A
1253A	962A	937A	466A	845B	1098A
1253C	1289A	459A	1228A	858A	968A
1275A	965A	450A	1253B	1176A	935A
1118A	565A	943A	1238A	737A	932A
1118B	564A	1239A	658A	824A	841A
838A	563A	828A	736A	744A	854A
972A	827A	739A	750A	753A	855A
946A	742A	741A	761A	839A	856A
458D	458C	767A	766A	714A	857A
949A	746A	863A	765A	938A	908A
458B	977A	947A	764A	738A	859A
970A	456A	1262A	763A	747A	860A
			923A	748A	907A
			732A	768A	751A
			717A	743A	862A
			934A	703A	942A
			740A	950A	924A
			969A	458A	1099A
			566A	700A	918A
			755A	731A	919A
			745A	724A	916A
			734A	715A	1168A
			1321A	455A	915A
			571A	457A	570A
			462A	569A	463A
			568A		

Area IVa **

Shallow*			Deep		
529A	1163A	622A	1129A	644A	627A
632A	634A	624A	622B	1165A	1160B
633A	627B	1160C	641A	1164A	
643A	621A				

Area IVb

Shallow*			Deep		
1269A			731A	847A	1250A
			697A	846A	1145A
			1159A	523A	1096A
			708A	523B	

TABLE 2

WELL PRIORITIZATION LIST

(Continued - page 3)

Priority 4 Wells (Non-domestic use, all depths, all areas)***

Area Ia

Shallow*	Deep
395B	403B, 1144B

Area Ib

Shallow*	Deep
309A, 309B, 1303A, 312A, 641B, 641C	No non-domestic-use deep wells identified in Area Ib

Area II (Non-domestic use)

Shallow*	Deep
552B, 1189A, 956B, 544A, 555B, 555D, 581B, 984B, 581C, 617B, 601B, 628A, 490B, 306B, 365B, 341B, 1060B, 866C, 332E, 866D, 1039A, 843B, 336D, 844B, 1172B, 336A, 613B, 336B, 485C, 336C, 494B, 339B, 545C, 312A, 557B, 985B, 1171B, 618A, 586C, 373B, 399B, 549B, 399C, 549C, 1173C, 866B, 960B, 486B, 959B, 981B, 611B, 580B, 485D, 1320A, 614B, 1185B, 1185C, 485B, 613C, 494C, 1172C, 556B, 359B, 1038A, 458E, 373B, 1171C, 611B, 589B, 1190B, 369B, 545B, 1218A, 1218B, 368B, 341C, 589C, 1068A, 988A, 1190C, 1006B, 733B, 992A, 571B, 990B, 977B, 989A, 486D	1006A, 306A, 562A, 399A

TABLE 2

WELL PRIORITIZATION LIST

(Continued - page 4)

Area III

Shallow*			Deep		
738B	465B	937B	851A	850A	735A
734C	1118C	731B			
938B	1255B	745B			
1238B	1098B	571B			
748B	942B	863B			
740B	1228B	841B			
1172B	459B	459C			
739B	1172C	968B			
977B	1253C	734B			
458E	456B	456C			
767C					

Area IVa **

Shallow*			Deep
641B	641C	1165B	No wells identified
643B	644B		

Area IVb

Shallow		Deep
731B	697B	1179A

Notes:

* Generally less than 100 feet. Questionable, Denver and unknown aquifers wells are also included in this category.

** Many of the wells in this area have not yet been surveyed and may not be included in this list.

*** Army test wells are generally excluded from all categories (not listed).

List excludes dry wells, unused and inoperable wells (e.g., no pump, no electricity, sealed, etc.). ID Numbers are TCHD designated numbers.

Domestic-use wells include business-use wells used for employee restrooms, coffee, etc.

Well locations are shown in Figures 6 and 7.

TABLE 3

WELL PRIORITIZATION FACTORS

AND SAMPLING FREQUENCY SUMMARY

WELL LOCATION AREA	WELL USE TYPE	WELL DEPTH	LABORATORY ANALYSIS	FIELD TESTS
I	Domestic	S	Annual	---
I	Domestic	D	once in 2-year period	every 6 months
I	Irrigation	S or D	As needed	---
I	Other	S	As needed	---
	Other	D	As needed	every 6 months
II	Domestic	S	Once in 2-year period	every 6 months
II	Domestic	D	Once in 2-year period	Every year
II	Irrigation	S or D	As needed	---
II	Other	S	As needed	---
II	Other	D	As needed	Every year
III	Domestic	S	Selected wells	---
III	Domestic	D	Selected wells	Every 2 years
III	Irrigation	S	As needed	---
III	Other	S	As needed	---
III	Other	D	As needed	Every 2 years
IV	Domestic	S	As needed	---
IV	Domestic	D	Selected wells	Every 2 years
IV	Irrigation	S or D	As needed	---
IV	Other	S	As needed	---
IV	Other	D	As needed	---

* S indicates a shallow well; D indicates a deep well.

TABLE 4

SUMMARY OF SAMPLING AND FIELD TESTING PROCEDURES FOR TASK 1: SAMPLING OF PRIVATE WELLS

PARAMETERS (1)	SAMPLE CONTAINER (2)	PRESERVATIVES	FIELD MEASUREMENTS (3)
Volatile aromatics (4)	(2) 40-ml amber glass	Cool to 4 degrees C	pH, temperature, specific conductance, alkalinity, hardness
Volatile organohalogens (4)	(2) 40-ml amber glass	Cool to 4 degrees C	
GC/MS volatiles (4)	(2) 40-ml amber glass	Cool to 4 degrees C	
GC/MS semivolatiles/acid extractables	(2) 1-liter amber glass	Cool to 4 degrees C	
Organosulfur compounds	(2) 1-liter amber glass	Cool to 4 degrees C	
Organochlorine pesticides	(2) 1-liter amber glass	Cool to 4 degrees C	
Nitrogen phosphorus pesticides	(2) 1-liter amber glass	Cool to 4 degrees C	
Hydrocarbons	(2) 1-liter amber glass	Cool to 4 degrees C	
Anions	125-ml plastic (filtered)	(5) Cool to 4 degrees C	
Nitrate/ Nitrite	125-ml plastic (filtered)	(5) 0.5 ml H_2SO_4	
Arsenic	500-ml plastic (filtered)	(5) 0.5 ml HNO_3	
Mercury	500-ml plastic (filtered)	(5) 0.5 ml HNO_3	
ICP Metals (6)	500-ml plastic (filtered)	(5) 0.5 ml HNO_3	
Cyanide	1-liter plastic	1 ml NaOH	

TABLE 4

SUMMARY OF SAMPLING AND FIELD

TESTING PROCEDURES FOR TASK 1:

SAMPLING OF PRIVATE WELLS

(Continued, page 2)

NOTES :

(1) Parameters to be tested are listed in Table 1.

(2) All containers will have plastic screw caps.

(3) All samples will be kept in iced coolers immediately after collection.

(4) The volatile and DBCP samples will be filled completely and inverted after capping to assure no bubble is present. Care will be taken not to aerate the sample during collection.

(5) The filtering equipment utilizes a Geopump peristaltic pump with a 0.45-micron cellulose acetate filter.

(6) Analysis by Inductively Coupled Plasma (ICP) emission spectometry.

TABLE 5

PROPOSED SCHEDULE

APPROXIMATE START DATE	TASK
October, 1990	Development of Detailed Work Plan.
October, 1990	Startup of first quarterly sampling event for chemical analysis (about 25 private wells in inventory area). Startup of ongoing hardness/specific conductance field tests for deep wells in inventory area (annual testing of each deep well in inventory area), and follow up testing for wells closed or unavailable during initial survey.
October, 1990 (Ongoing)	Ongoing periodic update and additions to computer database and field truthing of maps/ aerial photographs for well survey data.
January, 1991	Startup of subsequent quarterly sampling programs for chemical analyses (about 25 private wells in inventory area).
April, 1991	Quarterly sampling event of about 25 private wells in inventory area.
July, 1991	Quarterly sampling event of about 25 private wells in inventory area. Annual update to computer floppy data base submitted to Army.
October, 1991	Quarterly sampling event of about 25 private wells in inventory area.
January, 1992	Quarterly sampling event of about 25 private wells in inventory area.
April, 1992	Quarterly sampling event of about 25 private wells in inventory area.
July, 1992	Quarterly sampling event of about 25 private wells in inventory area.
August, 1992	Update to computer floppy data base submitted to Army.
Quarterly, As test results are available	Letter reports to private well owners for results of laboratory analysis of chemicals, with comparison to health guidelines and interpretation of results.
As requested by Army	Air, soil, surface water sampling.
As needed	Attendance of RMA-related meetings and public information requests.

TABLE 5

PROPOSED SCHEDULE

(Page 2)

Quarterly	Attendance of and presentation of ongoing work at technical review meetings. 360 Degree well sampling and interpretation and recording of results into files and computer data base for well survey.

FIGURES

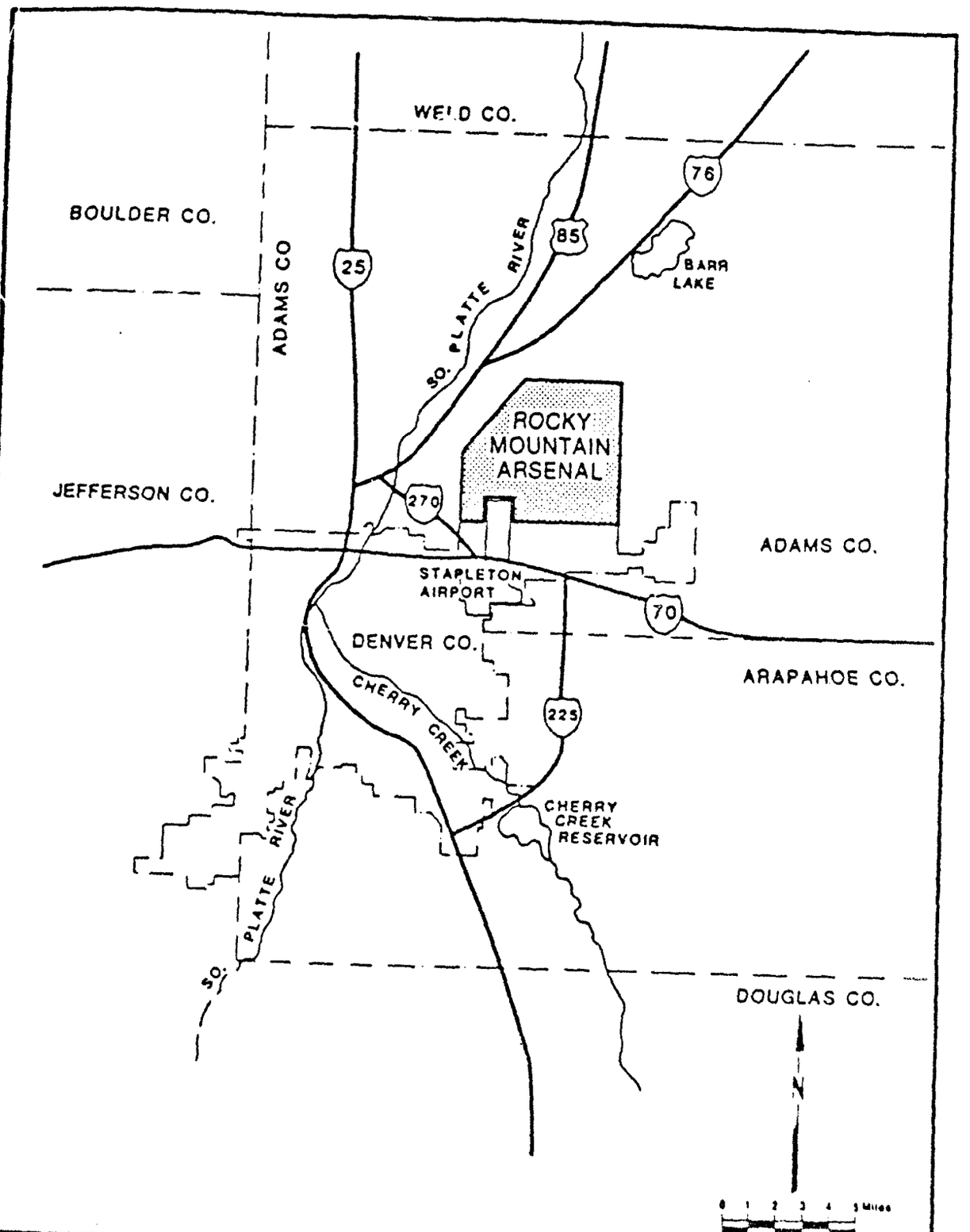


Figure 1
LOCATION MAP OF
ROCKY MOUNTAIN ARSENAL
SOURCE: ESE, 1988

Prepared for:
U.S. Army Program Manager's Office
For Rocky Mountain Arsenal
Aberdeen Proving Ground, Maryland

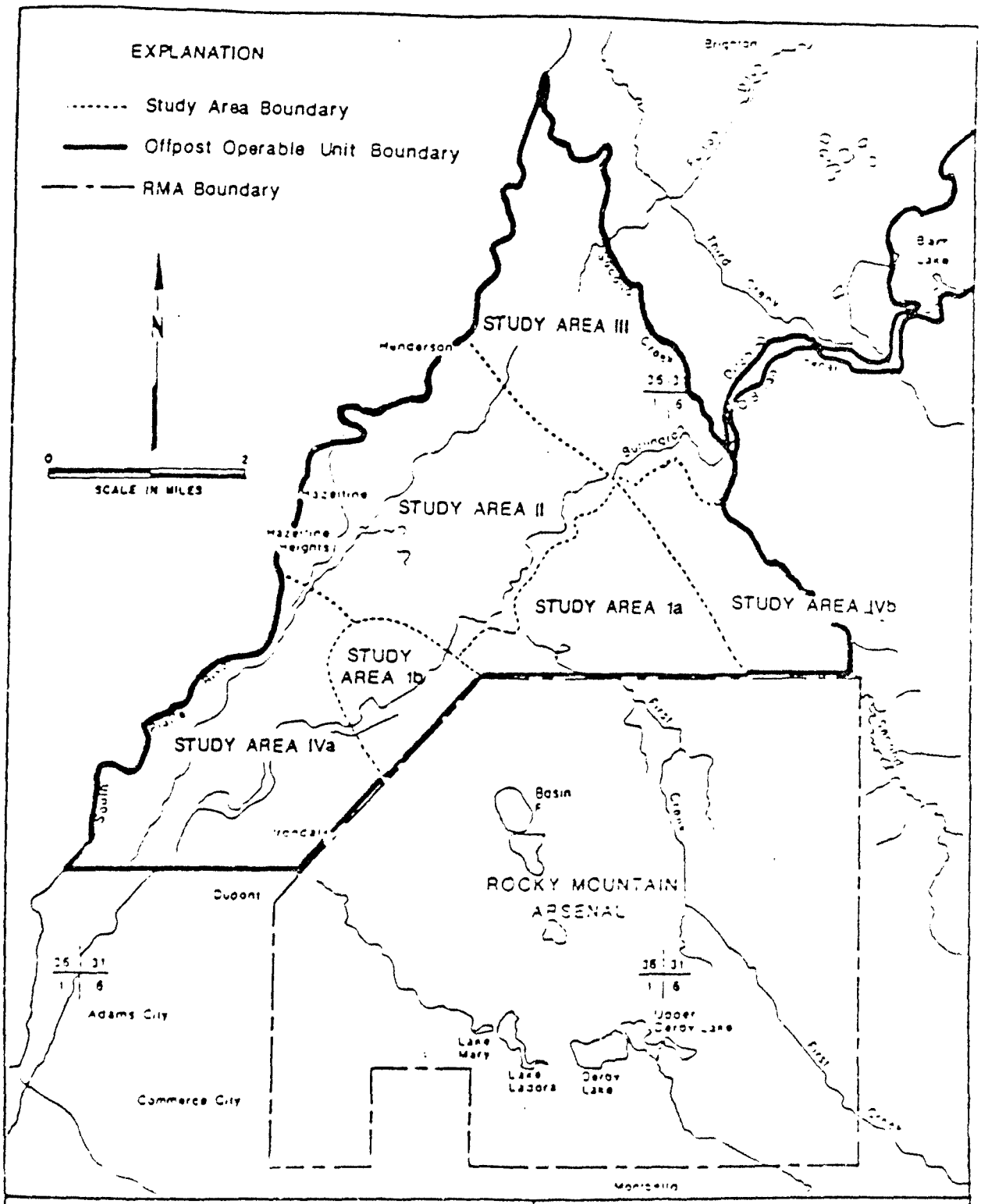
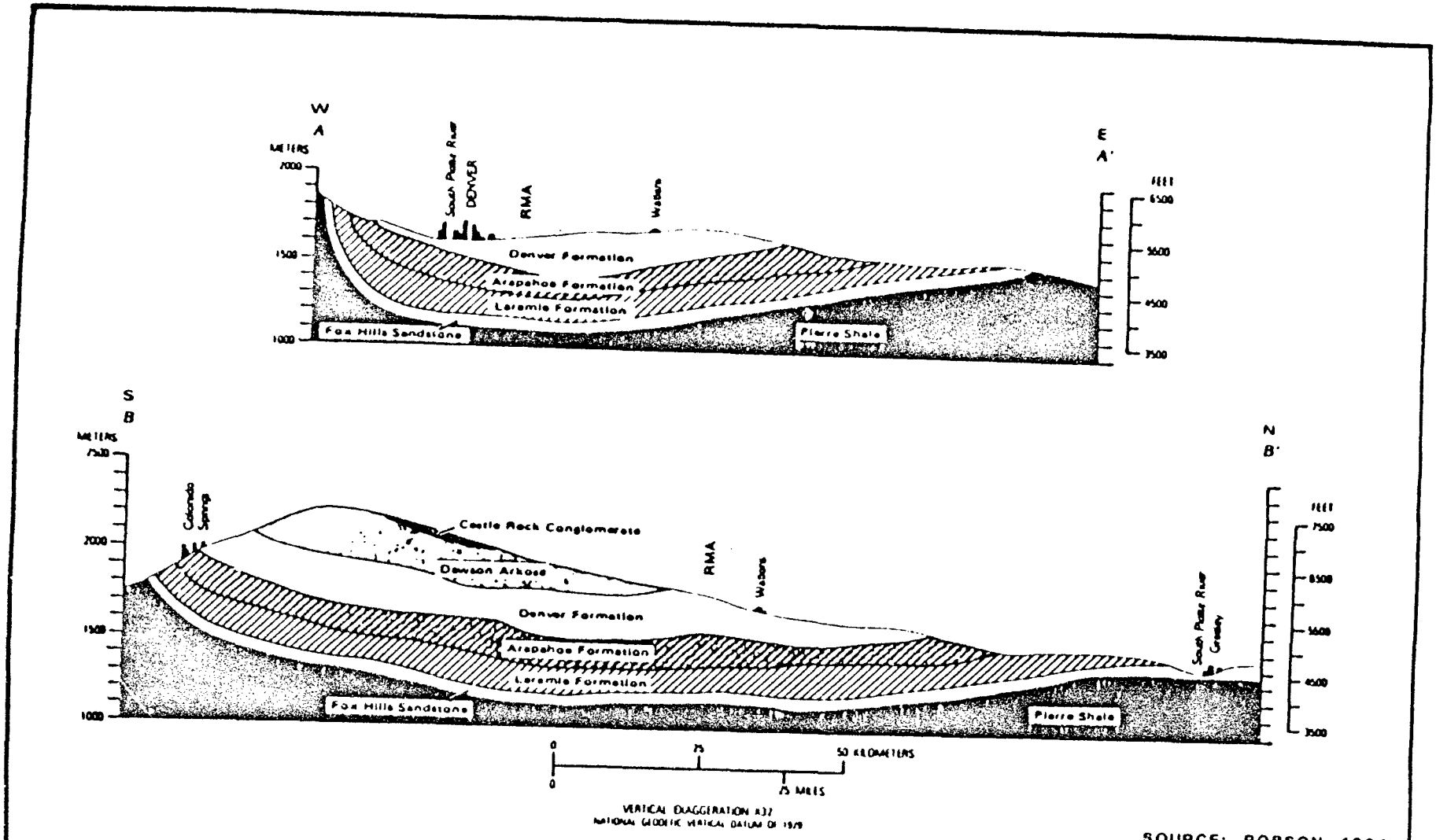


FIGURE 2
CURRENT INVENTORY AREA

SOURCE: ESE 1988

Prepared for:
U.S. Army Program Manager's Office
For Rocky Mountain Arsenal

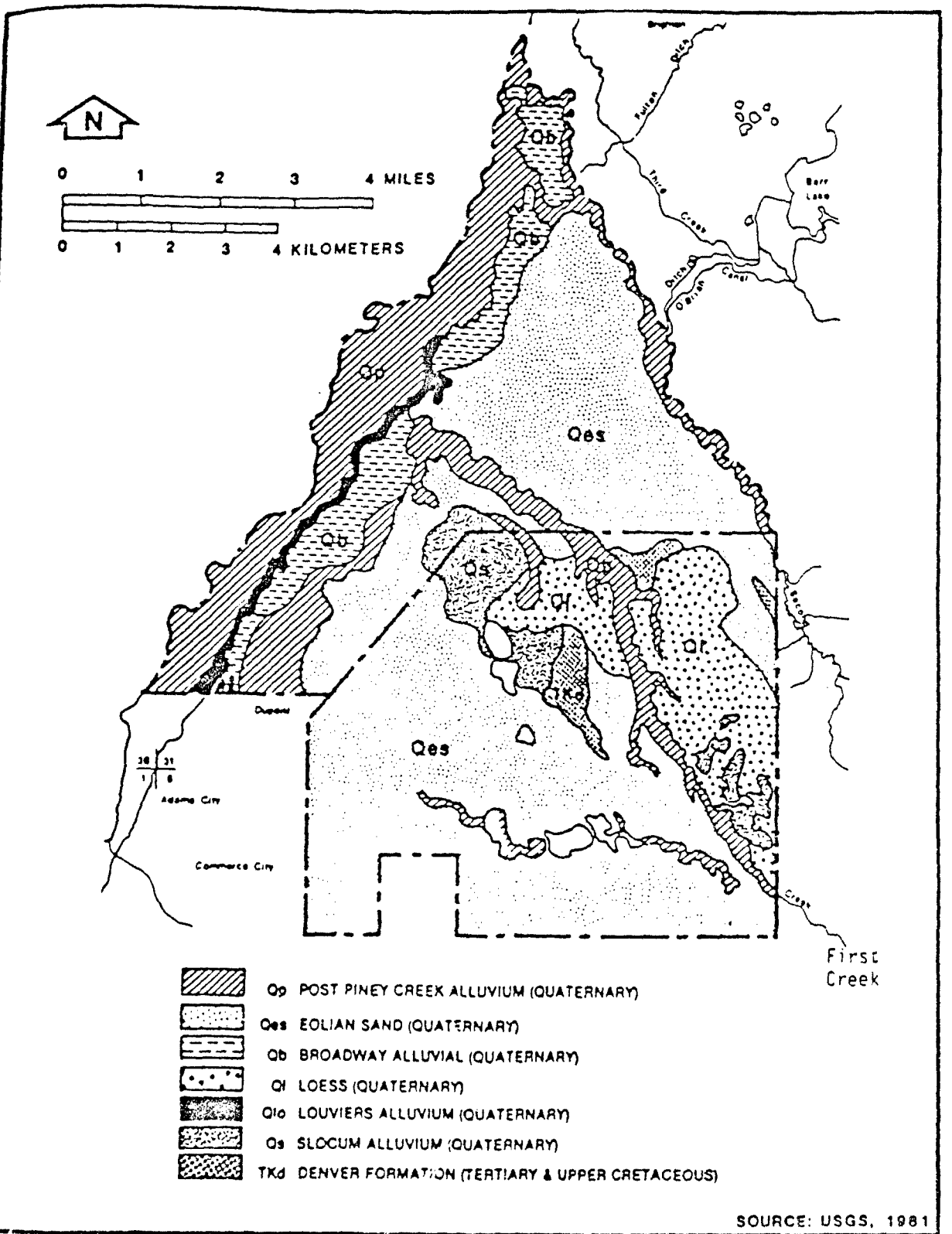
Aberdeen Proving Ground, Maryland



SOURCE: ROBSON, 1981

Figure 3
UPPER STRATIGRAPHIC SECTIONS OF DENVER BASIN

Prepared for:
U.S. Army Program Manager's Office
For Rocky Mountain Arsenal
Aberdeen Proving Ground, Maryland



SOURCE: USGS, 1981

Figure 4
GEOLOGIC MAP OF RMA AREA

Prepared for:
U.S. Army Toxic and Hazardous Materials Agency
Aberdeen Proving Ground, Maryland

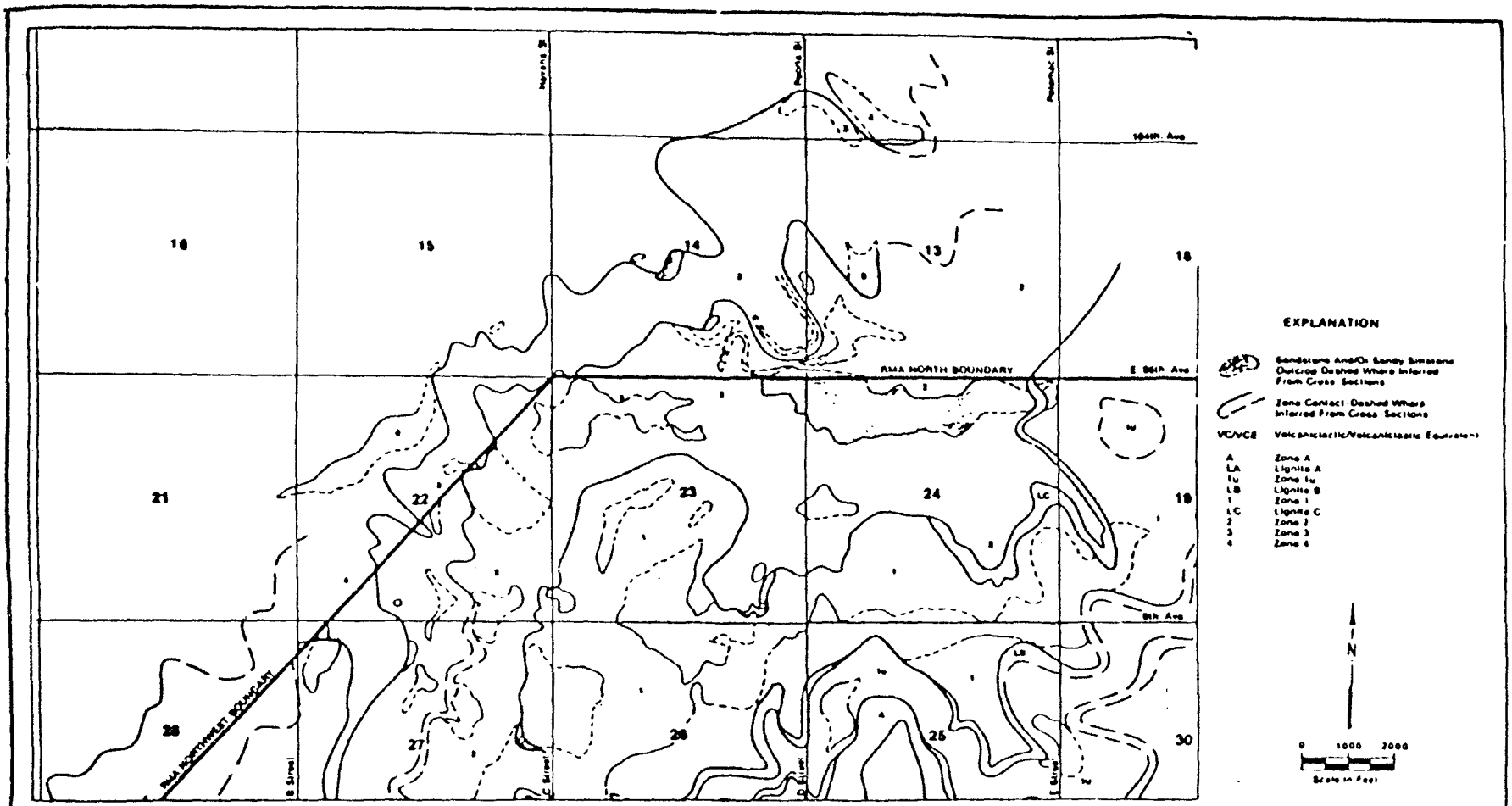


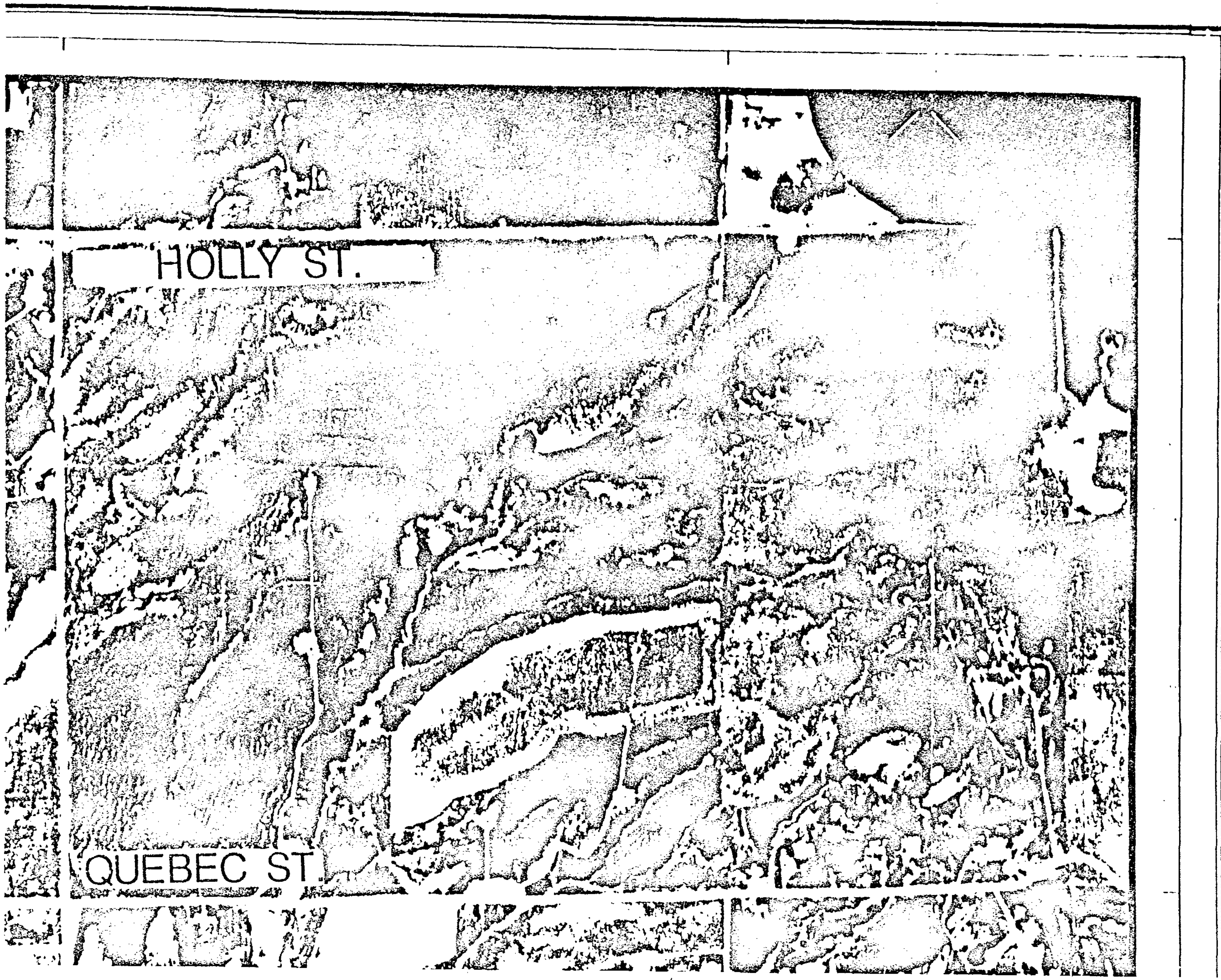
Figure 5

SUBCROP MAP OF DENVER FORMATION ZONES

SOURCE: ERE, 1988

Prepared for:
U.S. Army Program Manager's Office
For Rocky Mountain Arsenal

Aberdeen Proving Ground, Maryland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QUEBEC ST.

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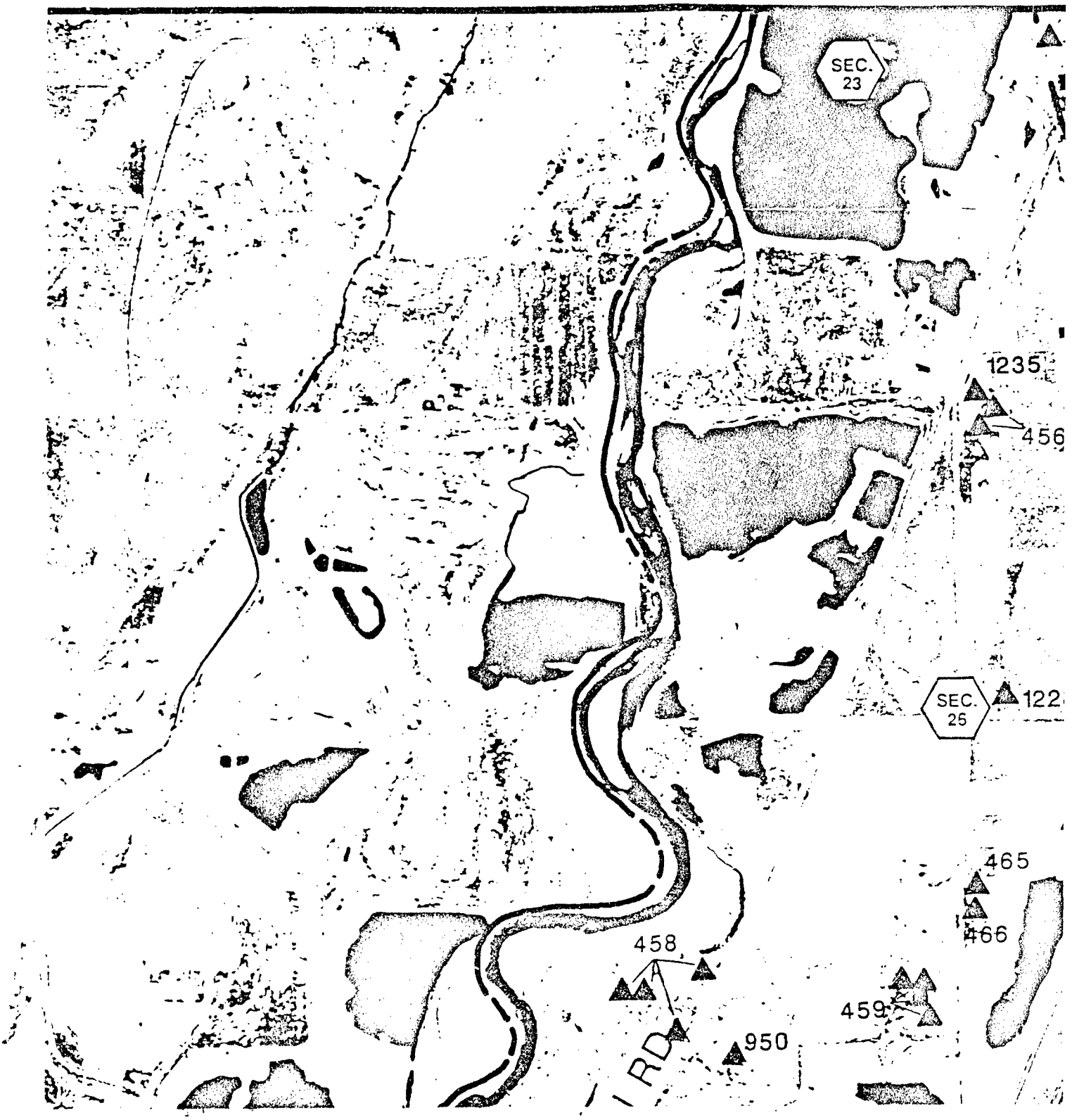
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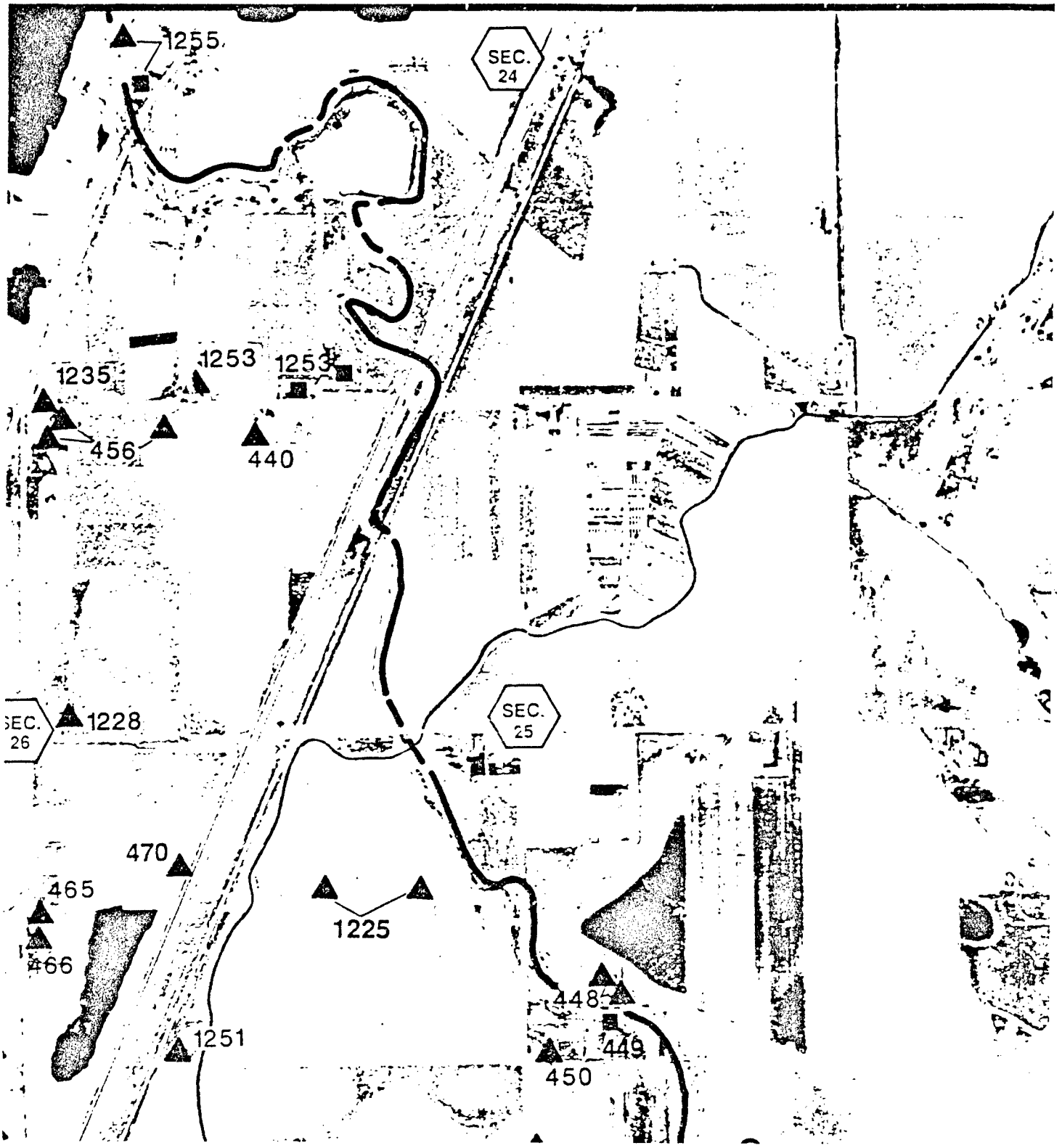
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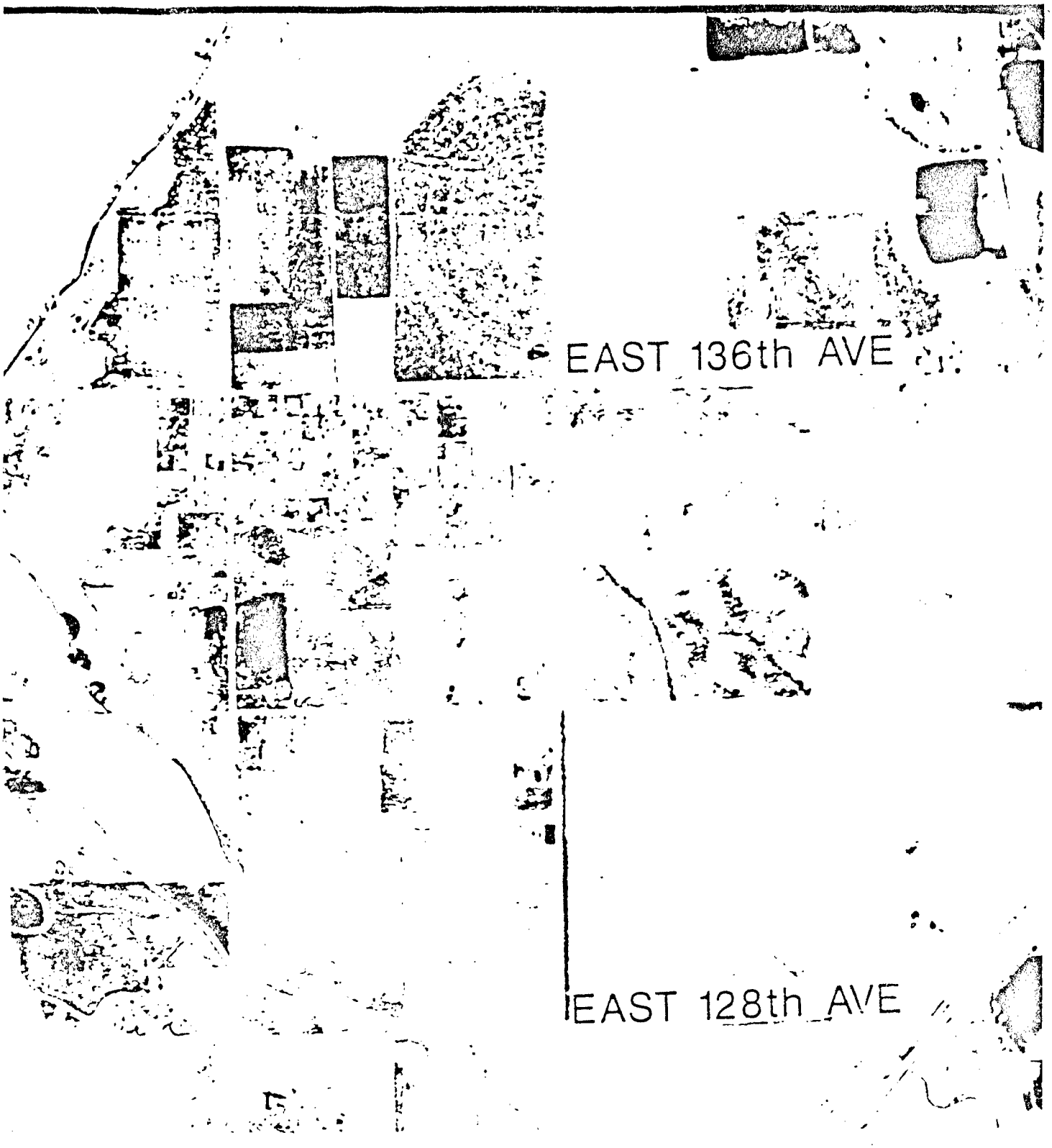

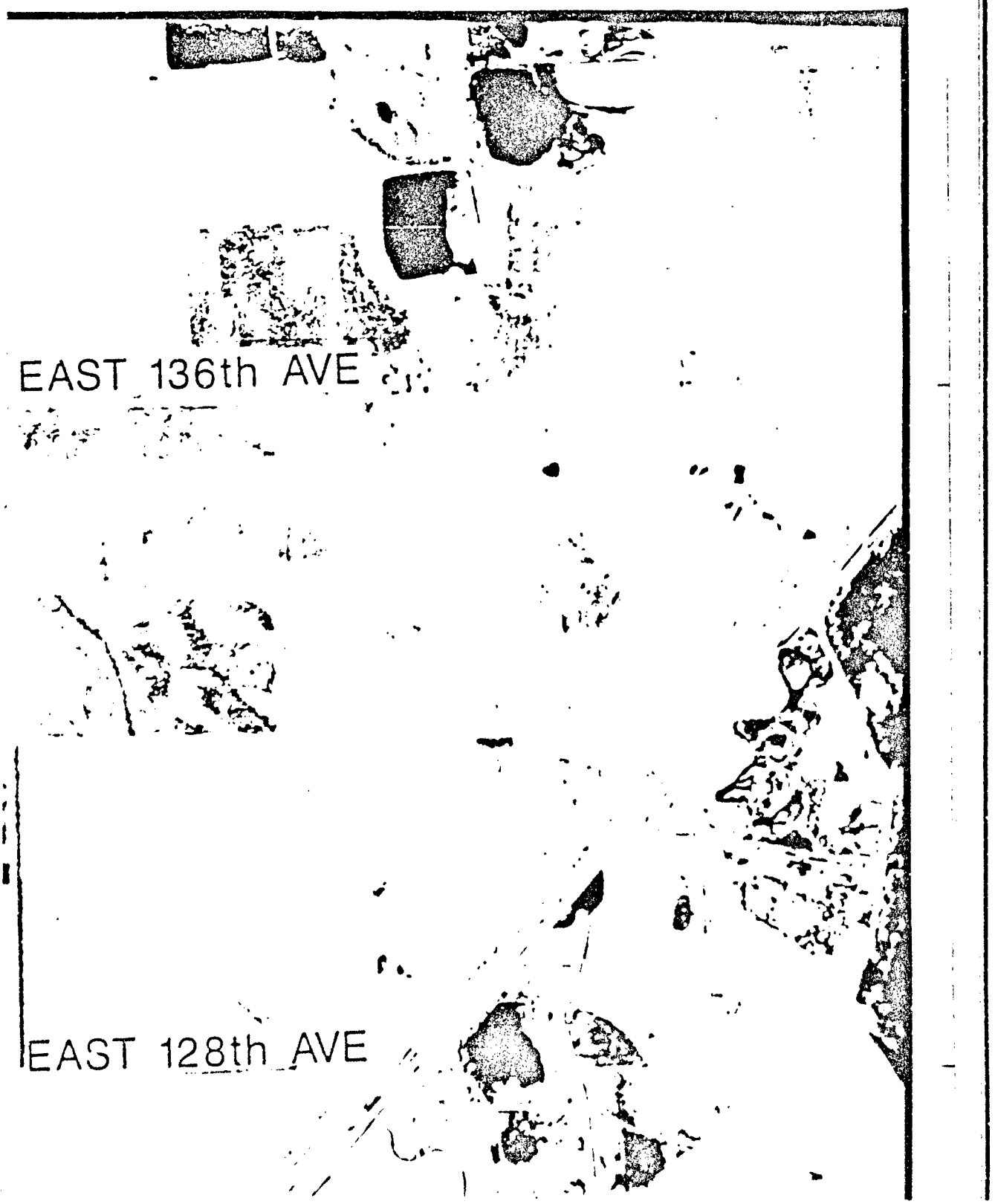
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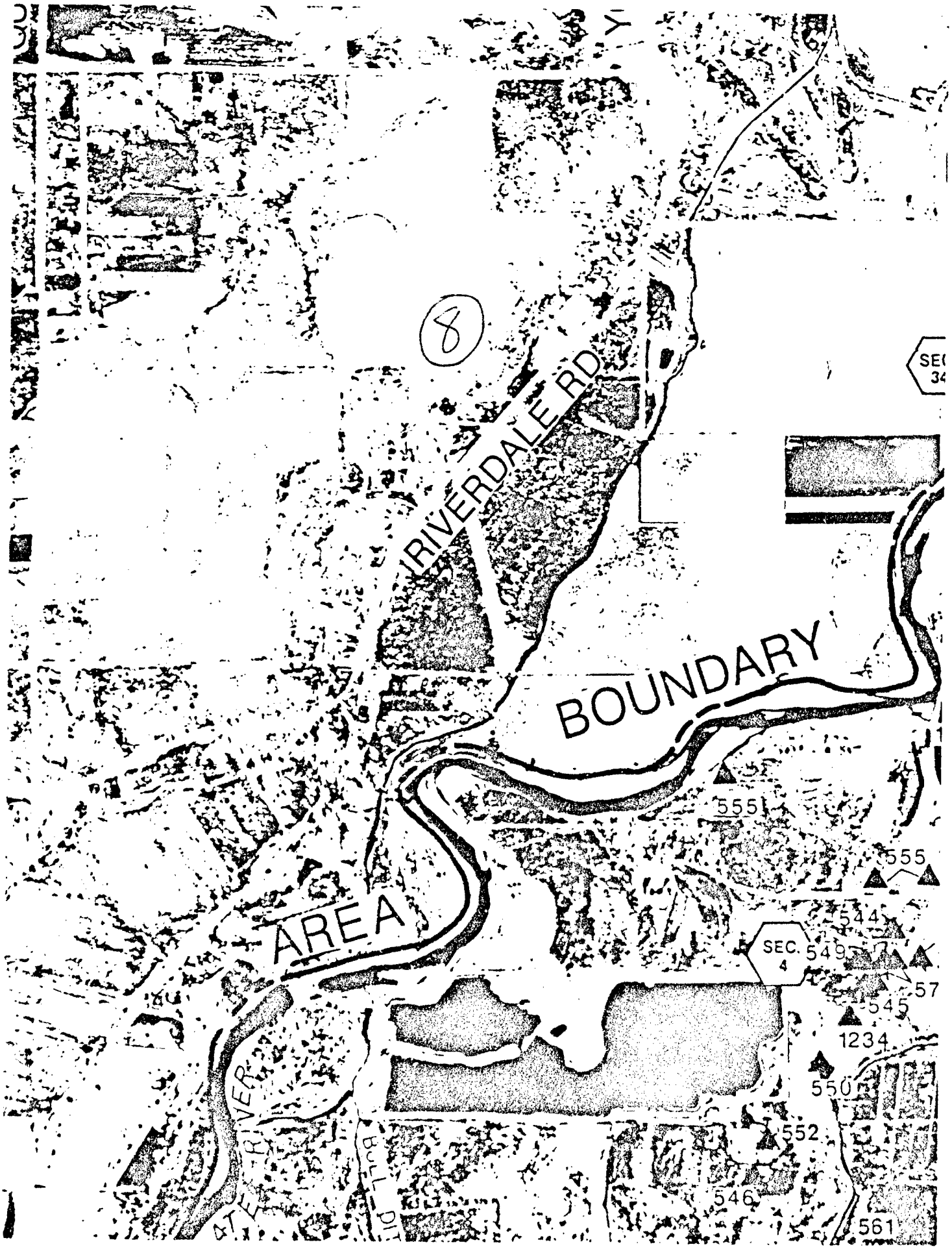
EAST 128th AVE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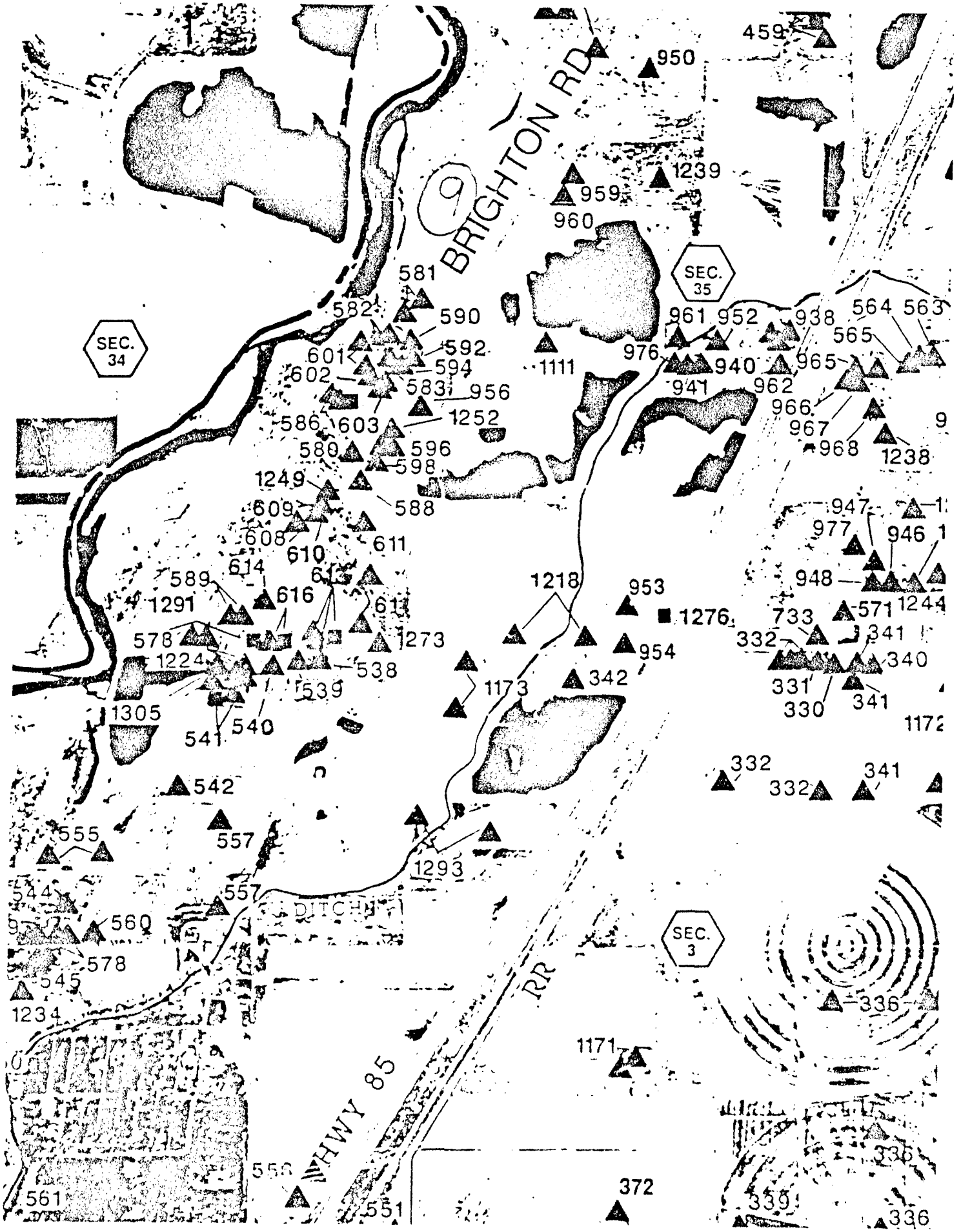
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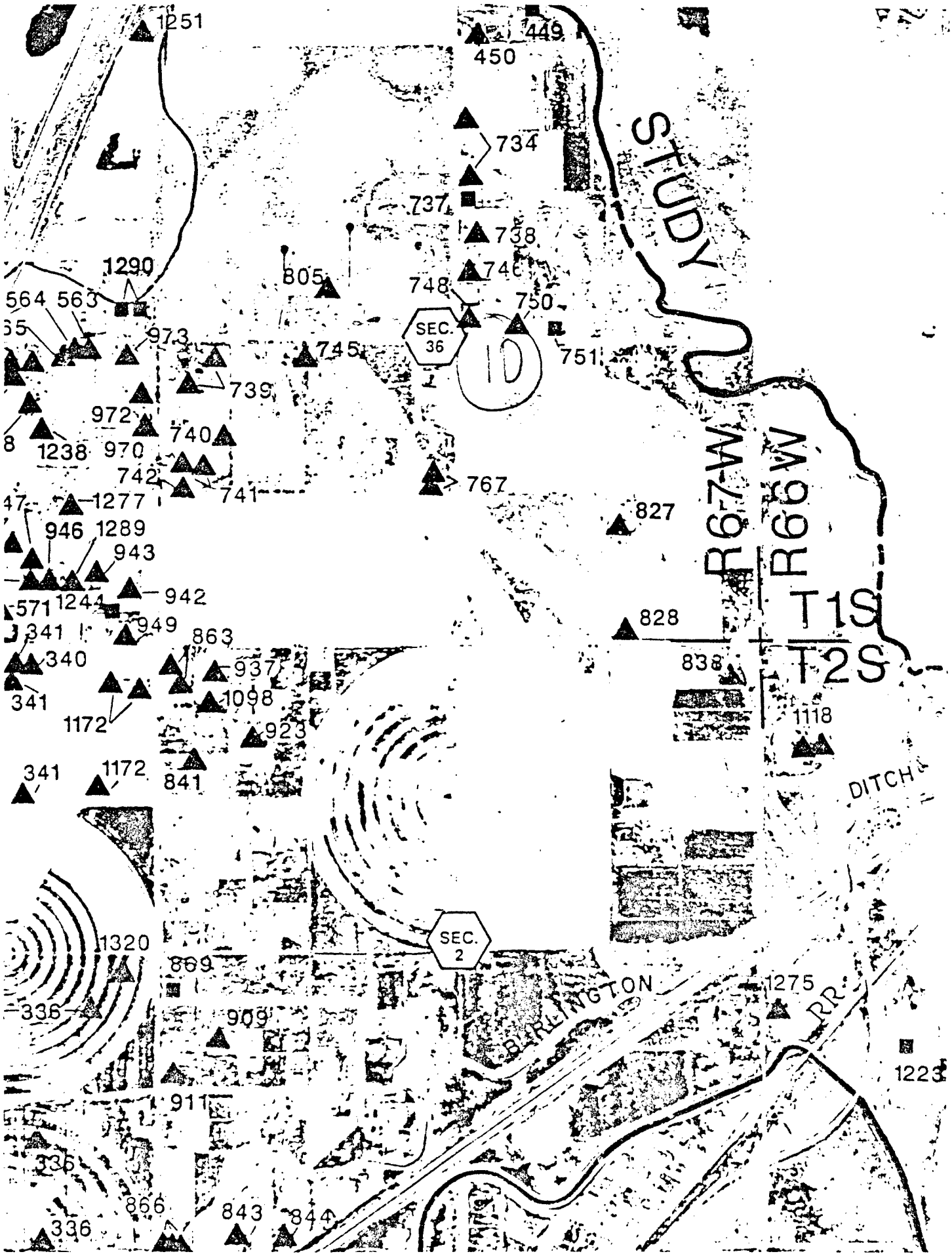
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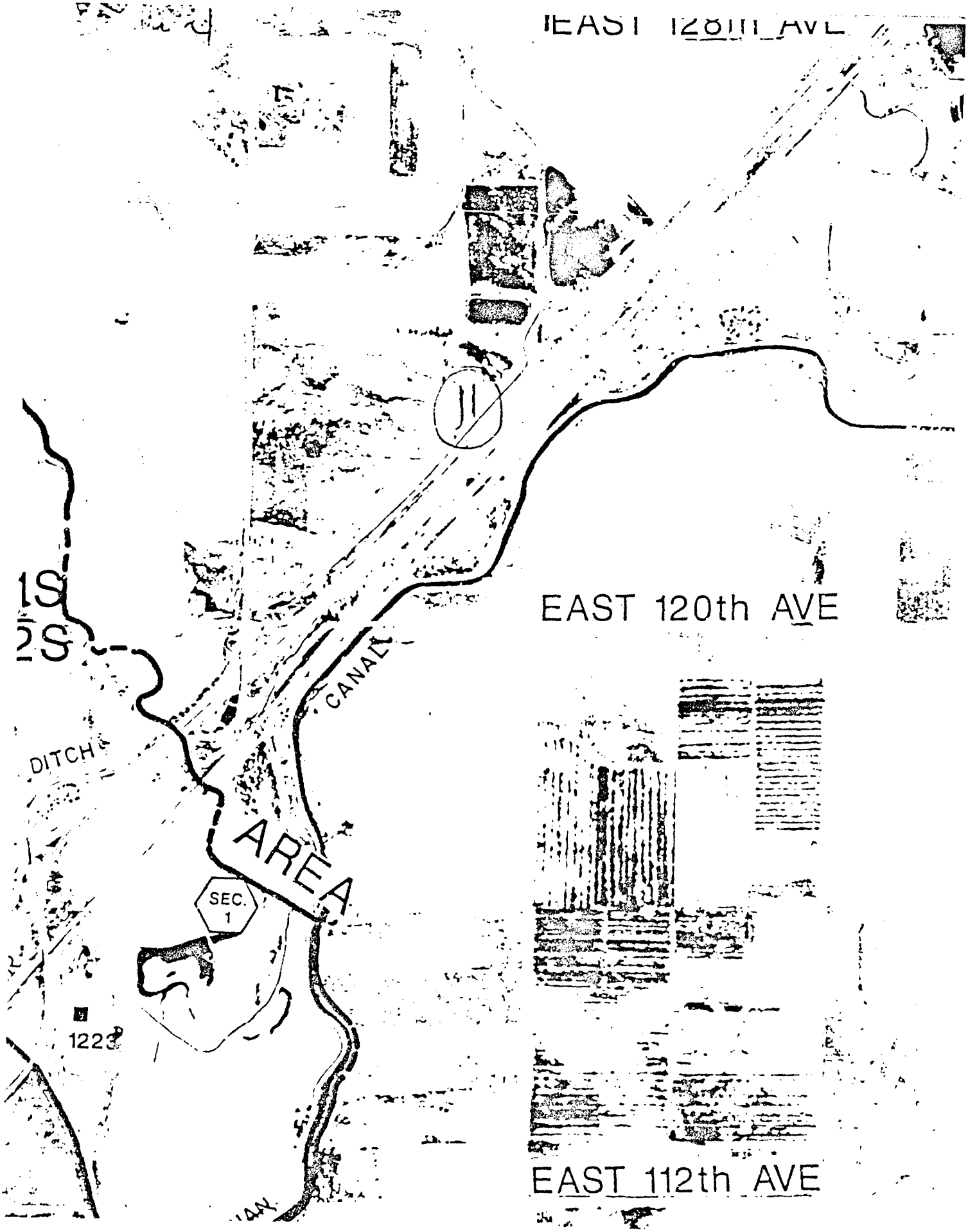
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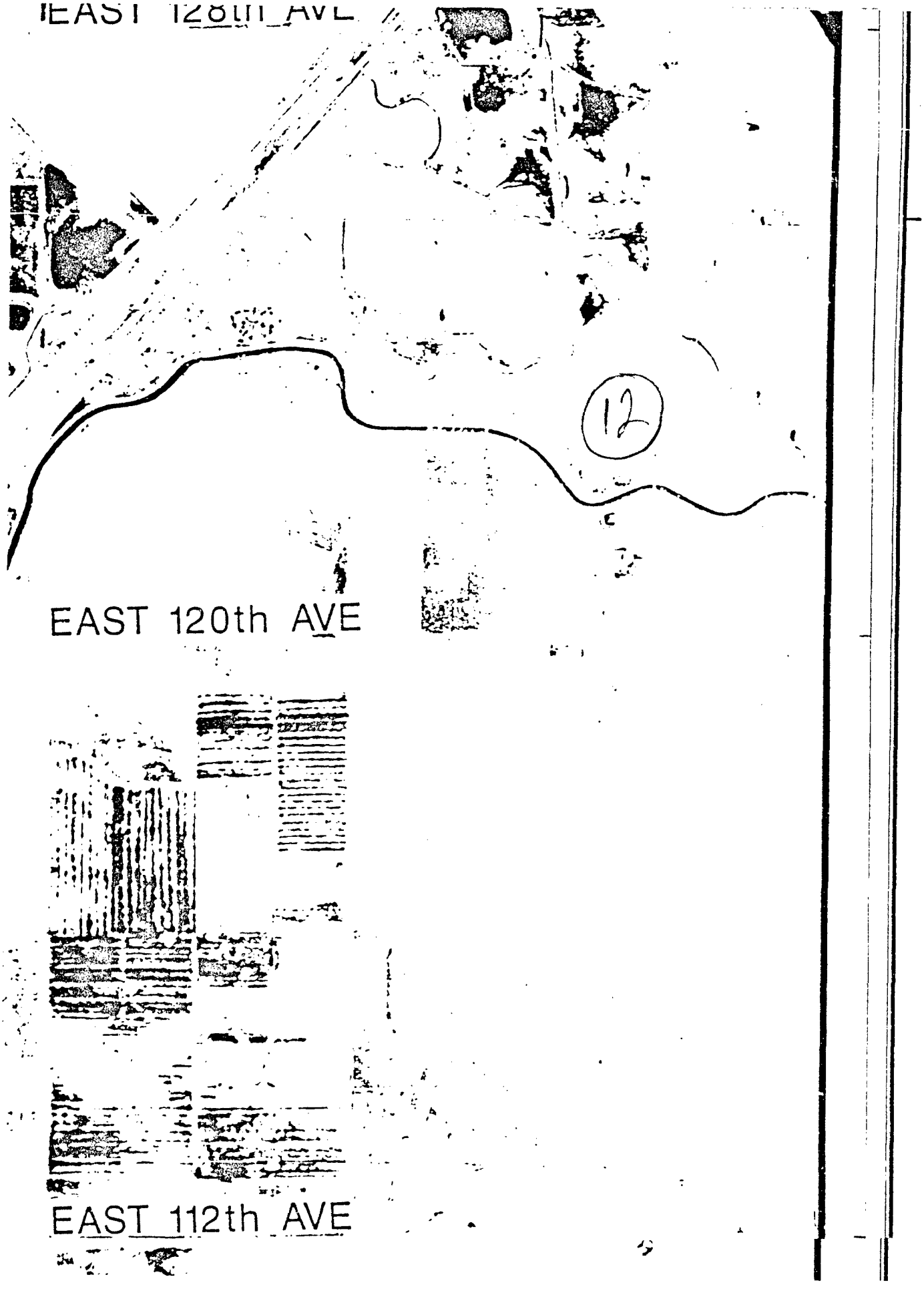
EAST 112th AVE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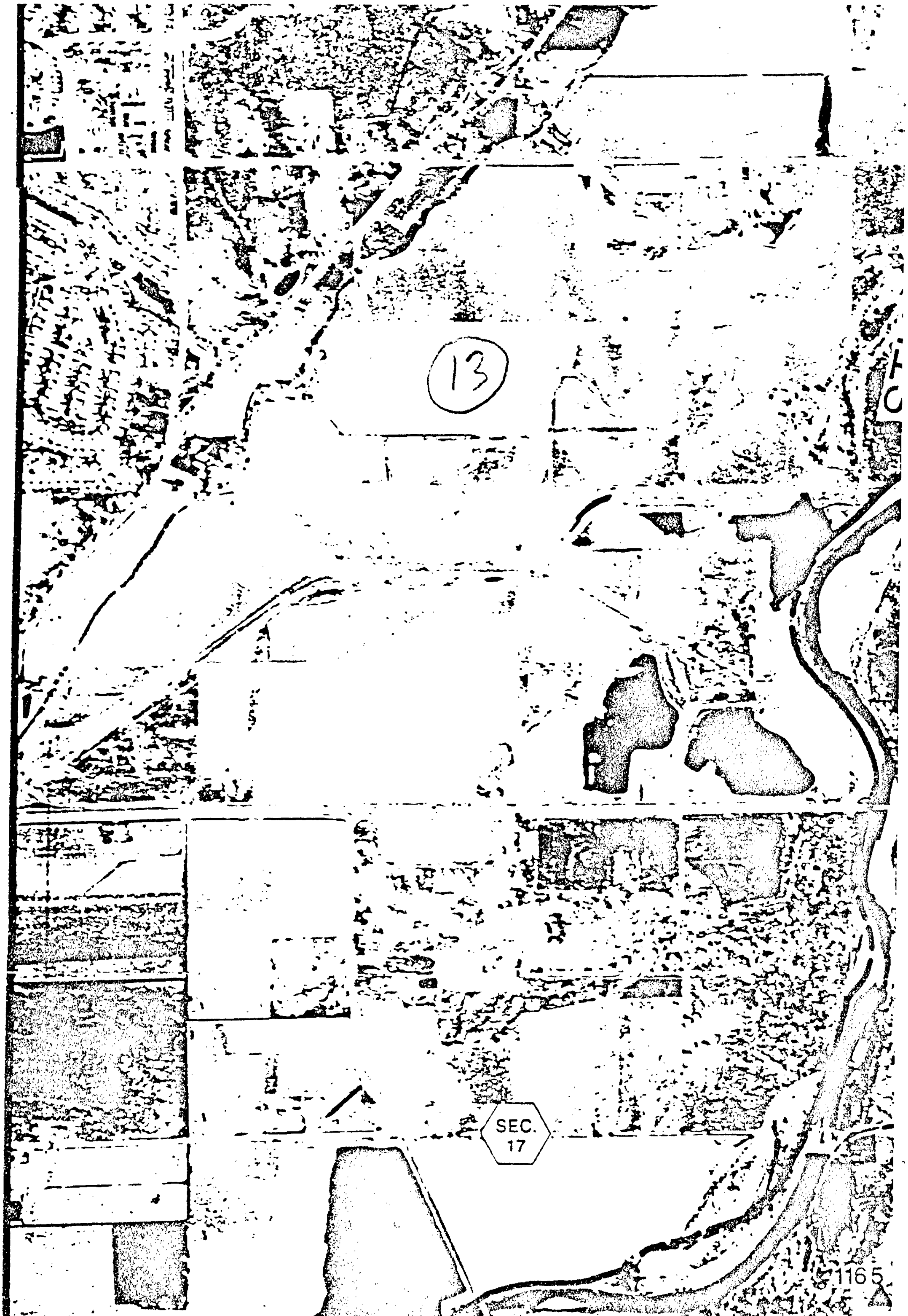
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BULL DITCH
FULTON
HAZELTINE HEIGHTS
SEC. 9
SEC. 16
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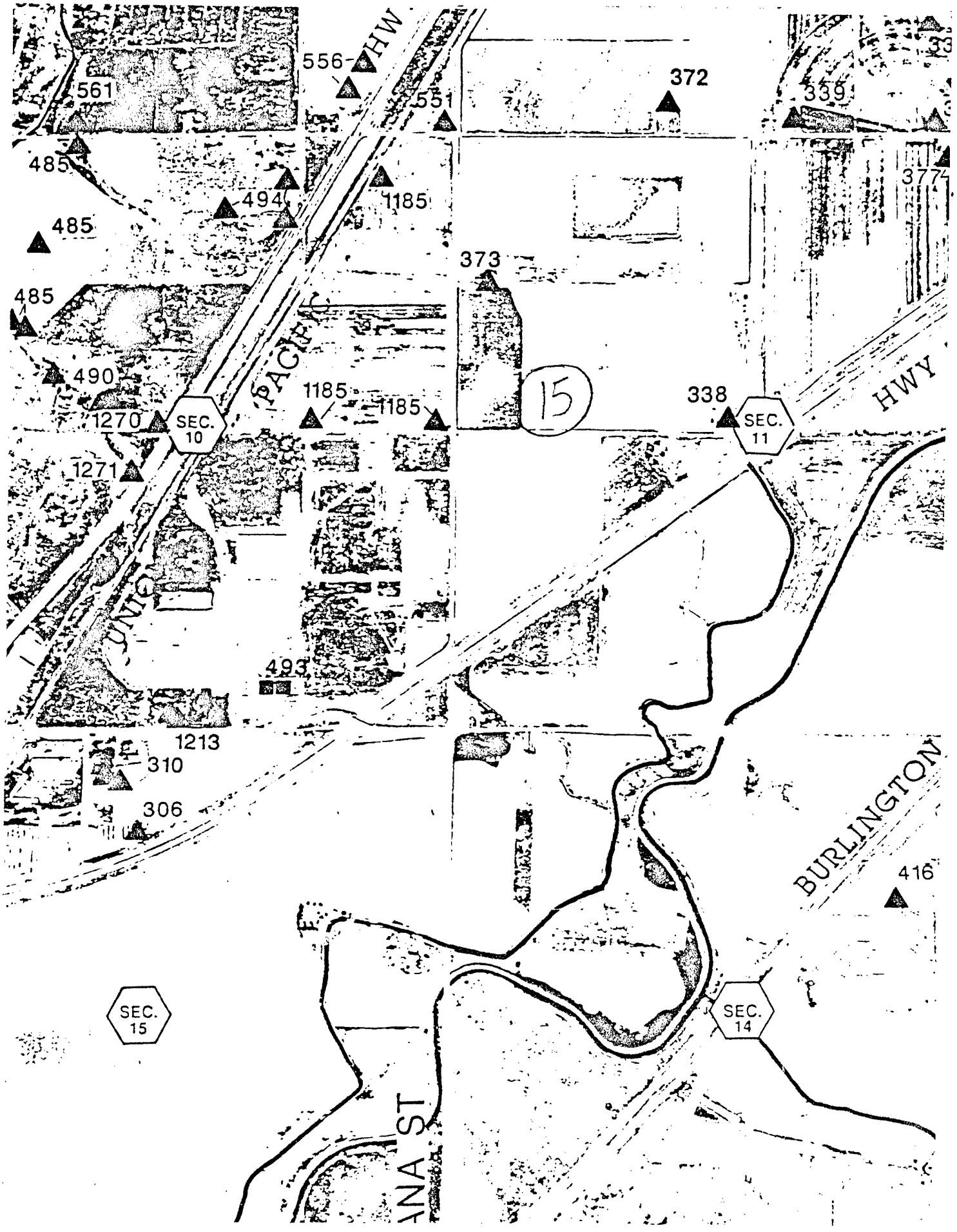
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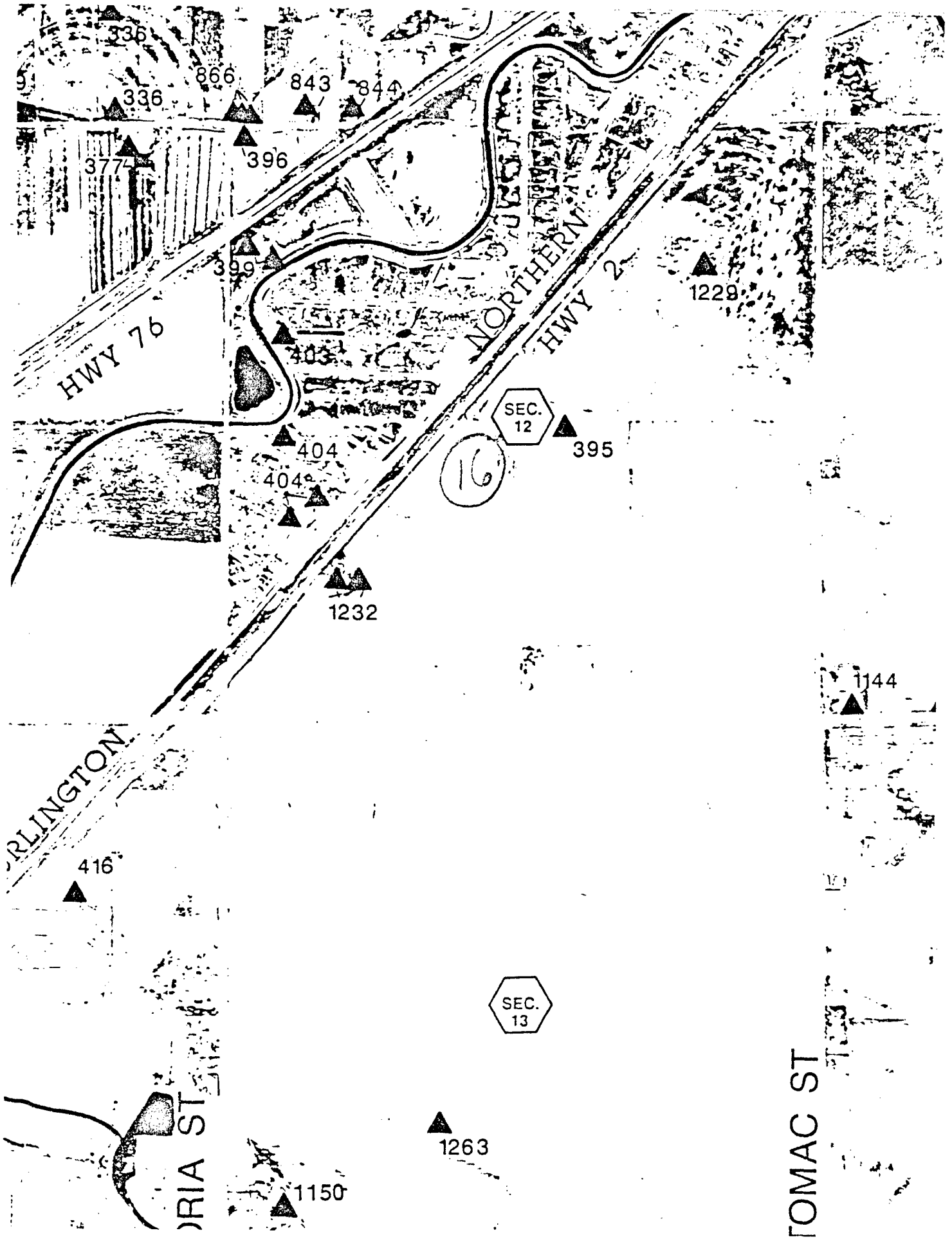
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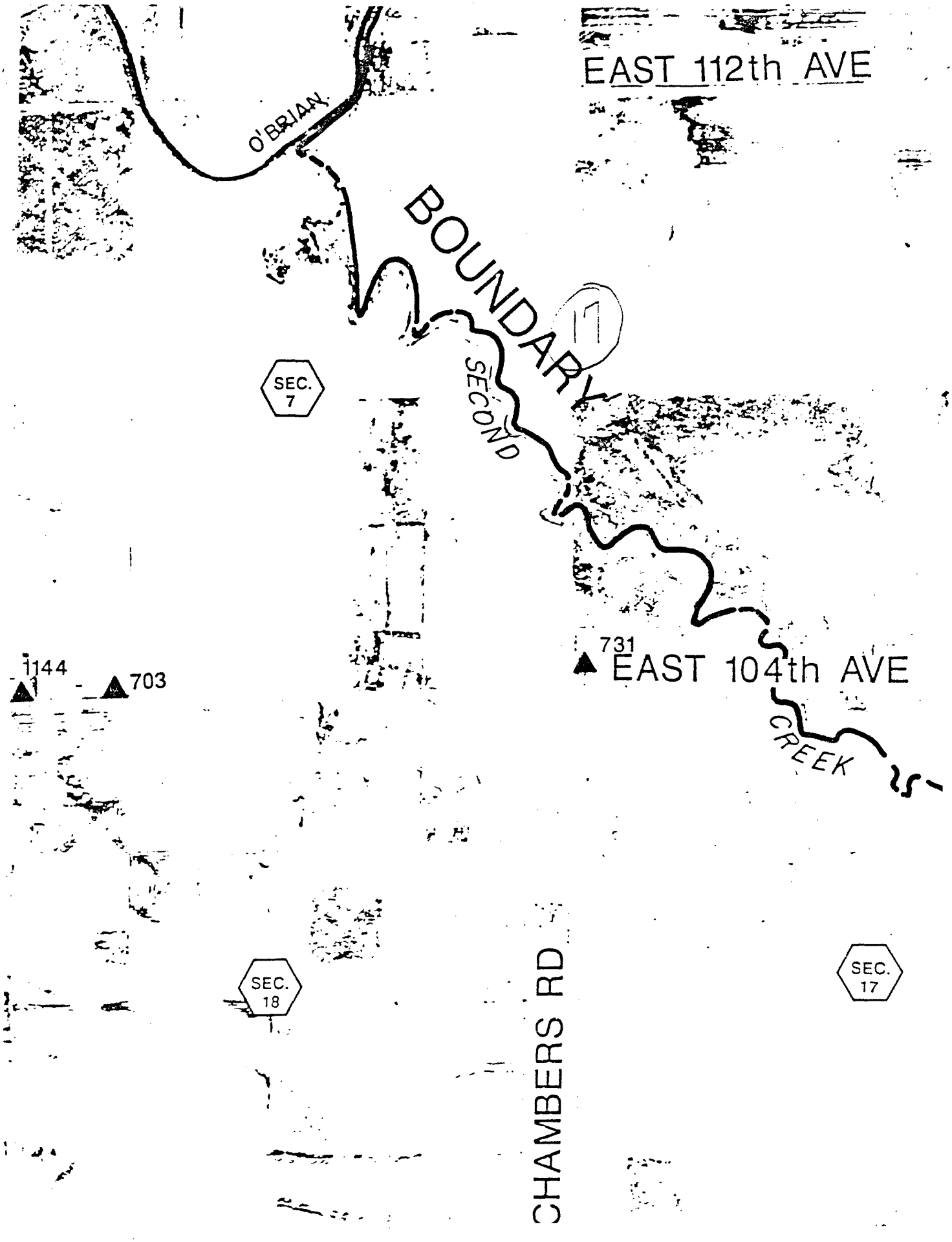
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SECOND
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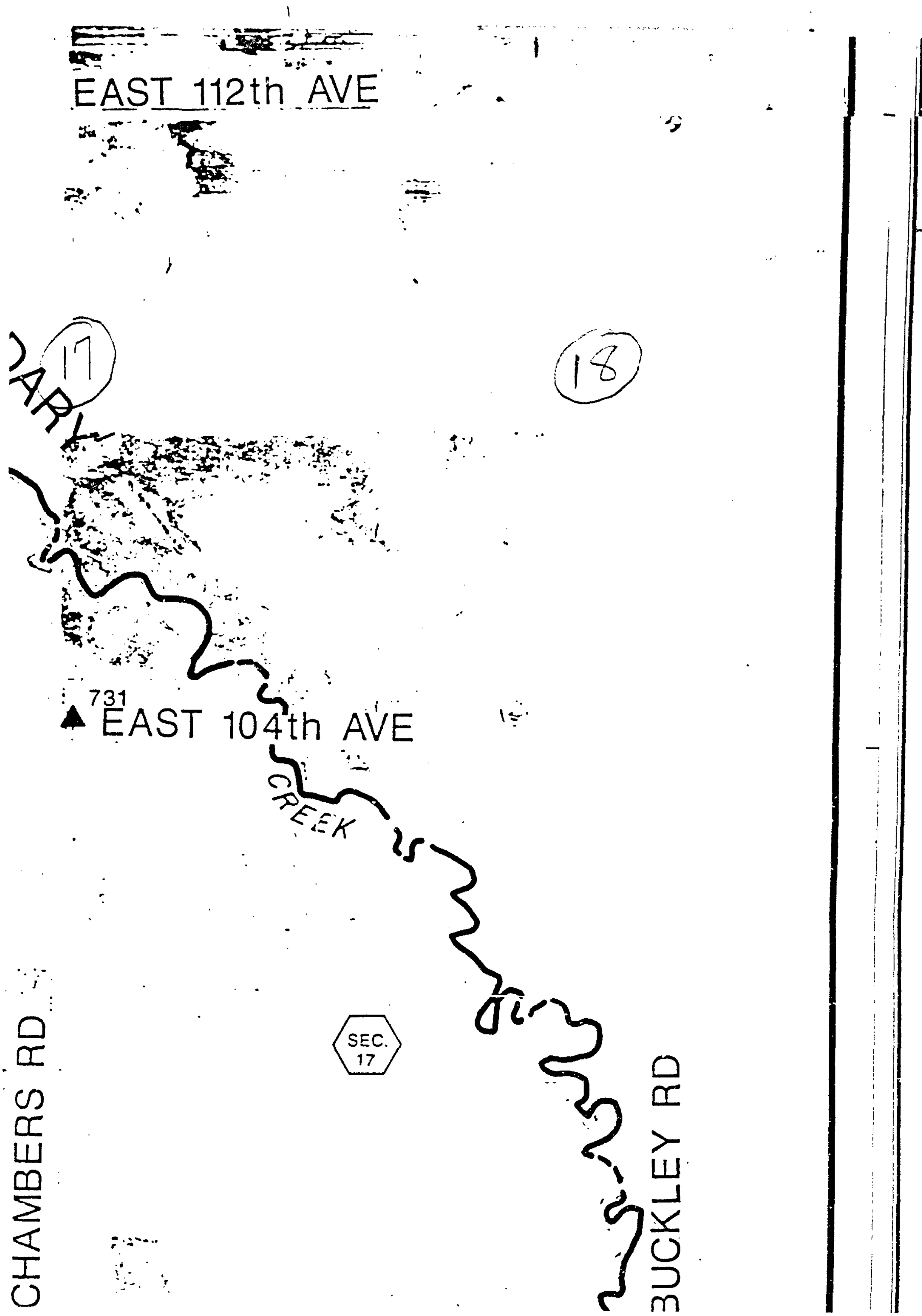
SEC. 17



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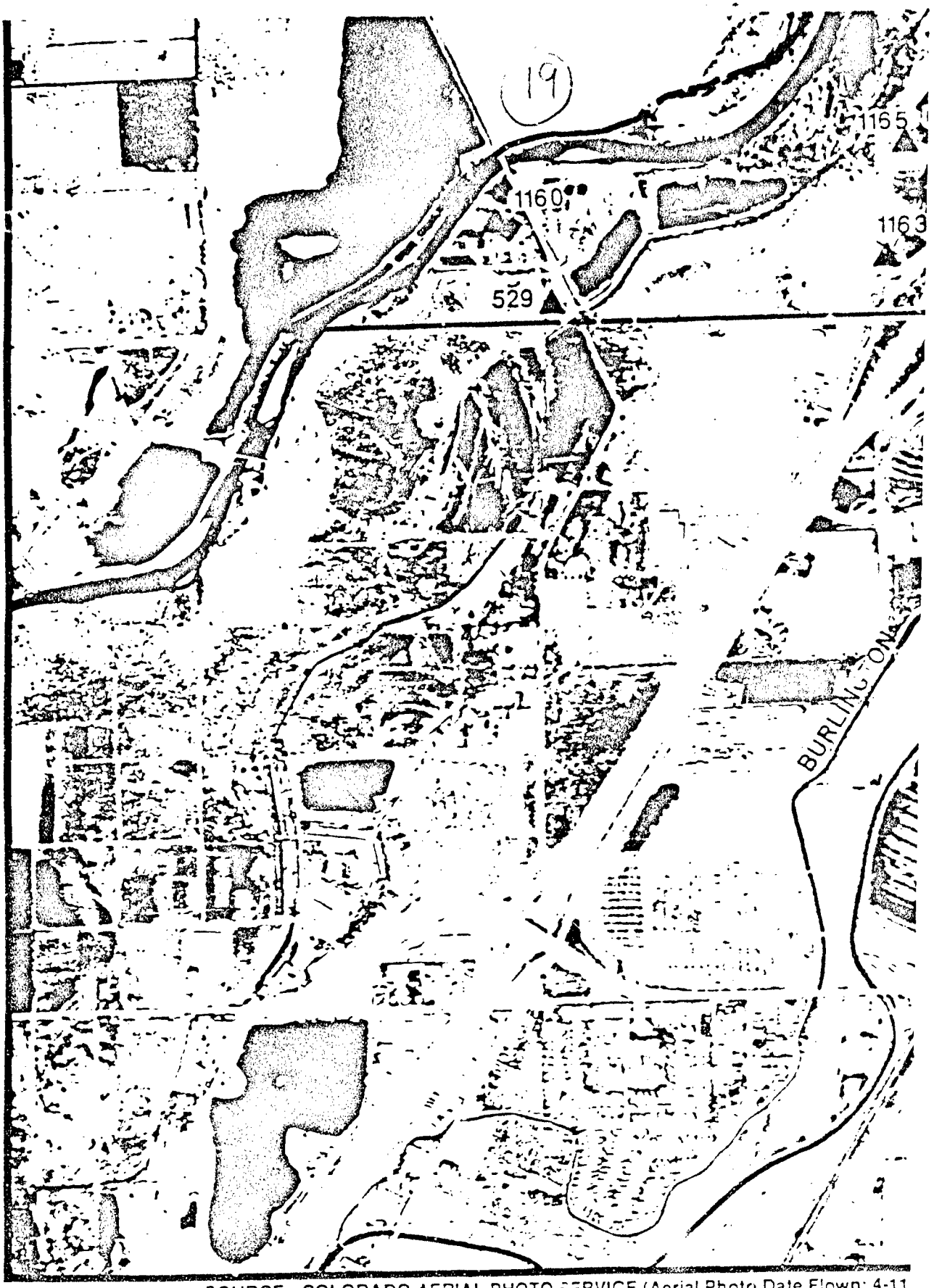

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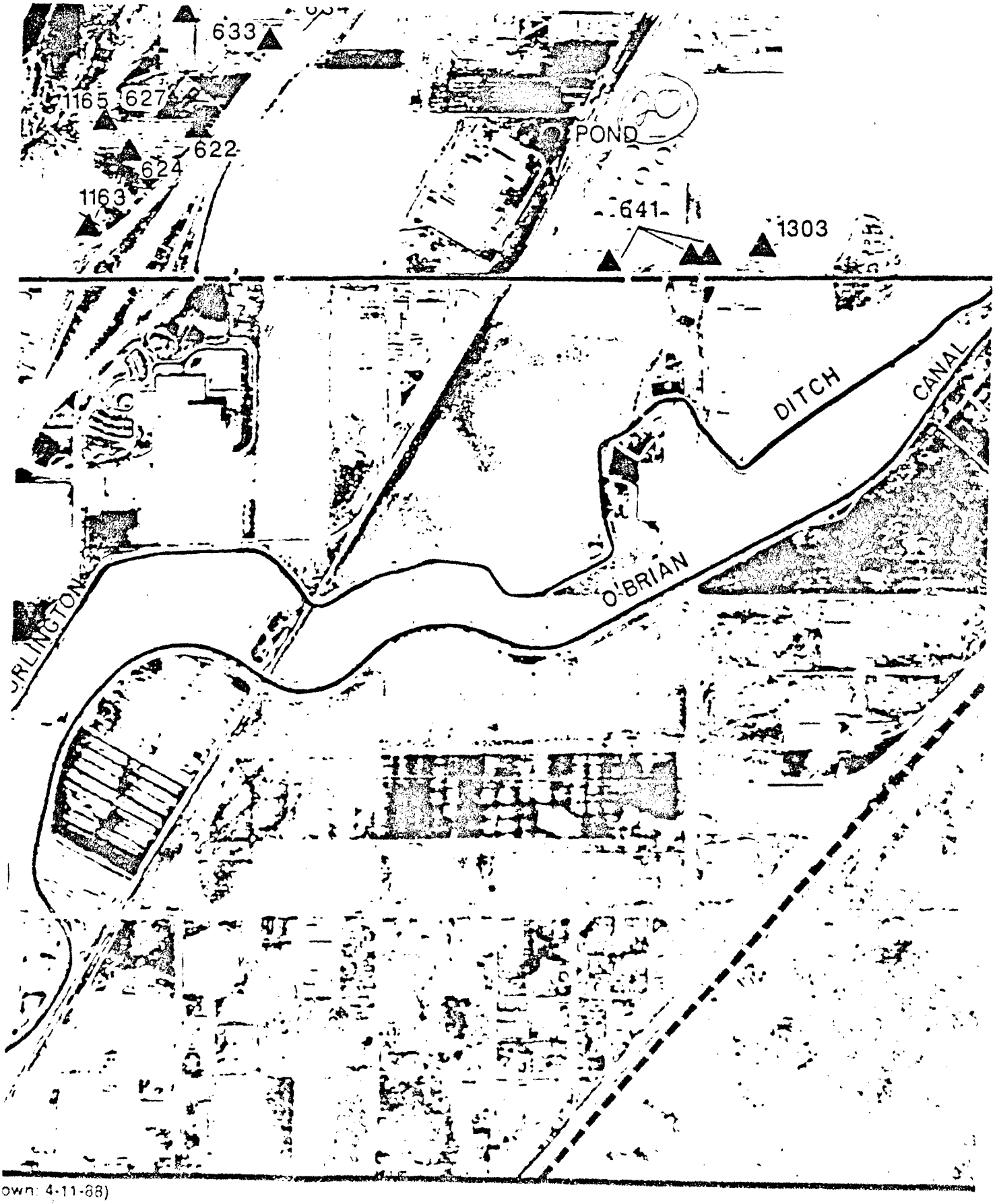

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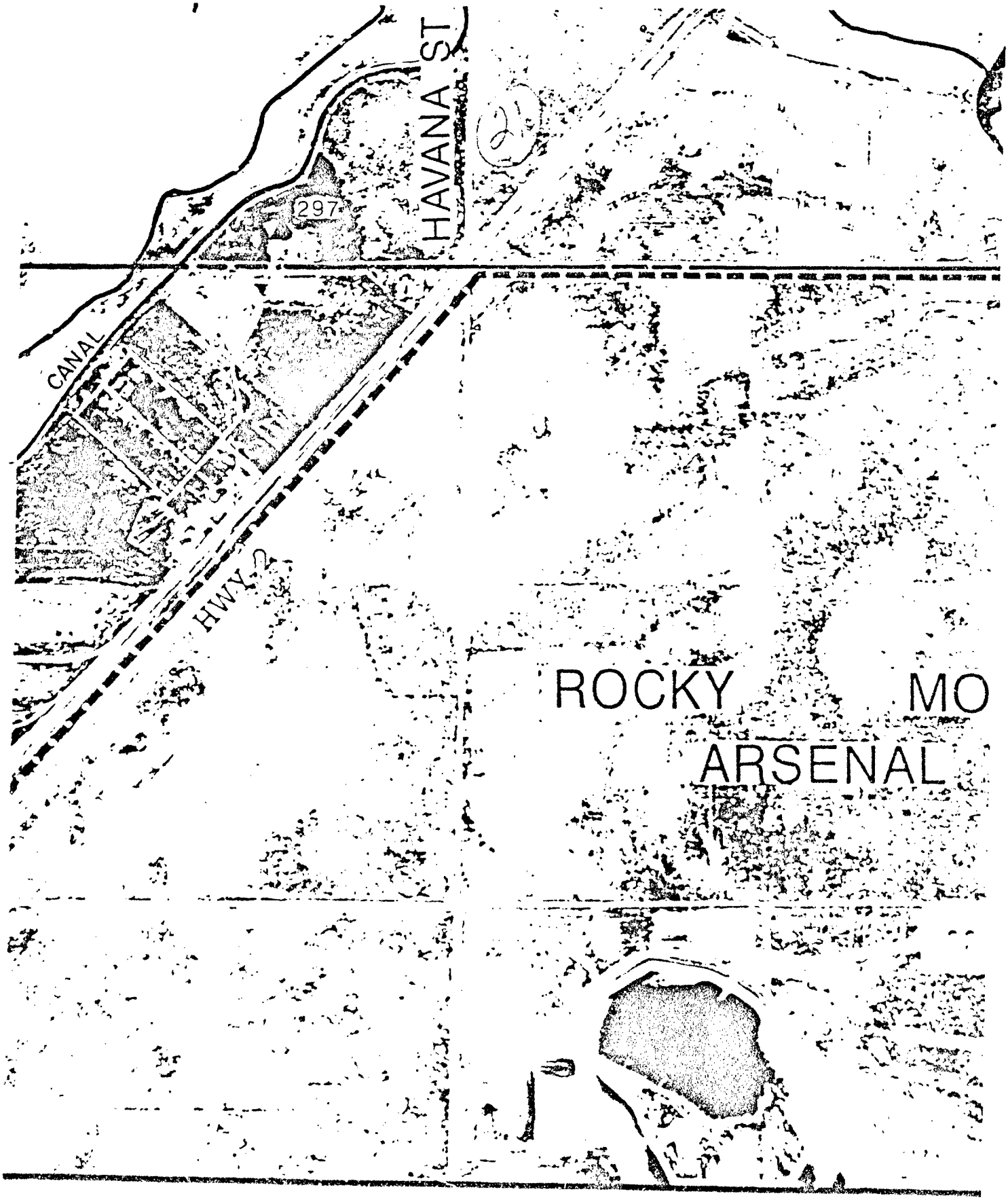
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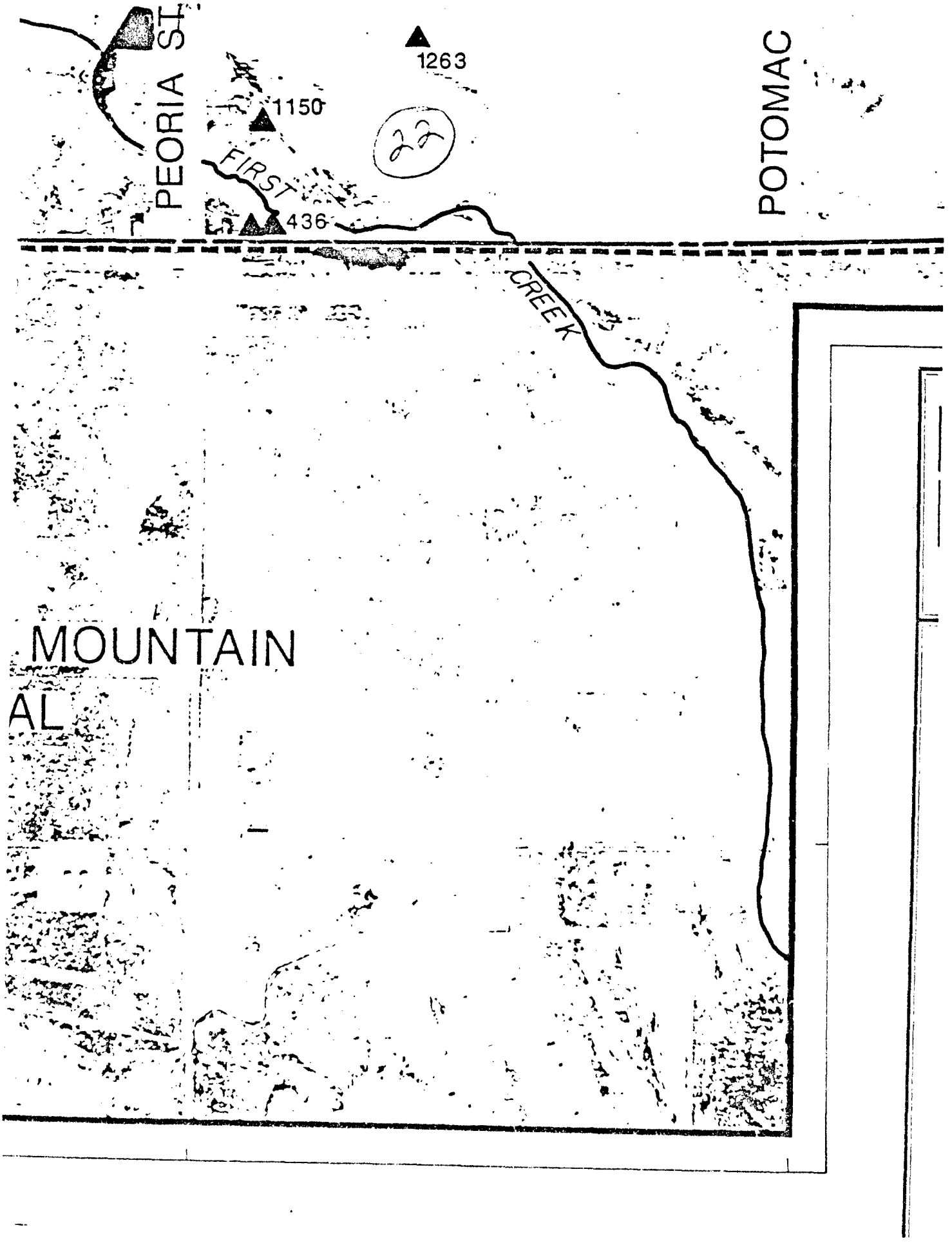
HWY. 2
ROCKY MO
ARSENAL


PEORIA ST
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FIRST
436
POTOMAC
CREEK
MOUNTAIN
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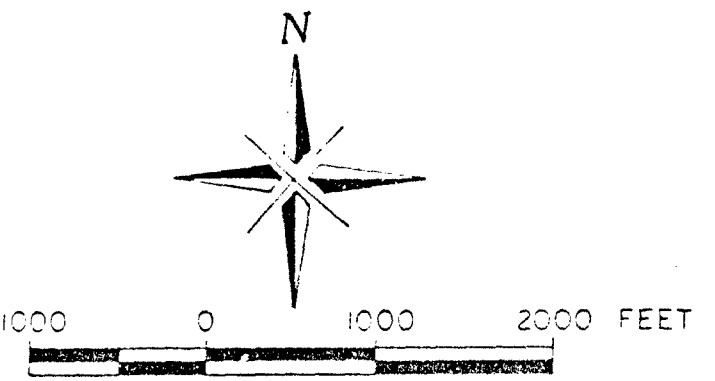
CHAMBE

(23)

EAST 96th AVE

Tri-County Health Dep

Serving Adams, Arapahoe and Douglas Co



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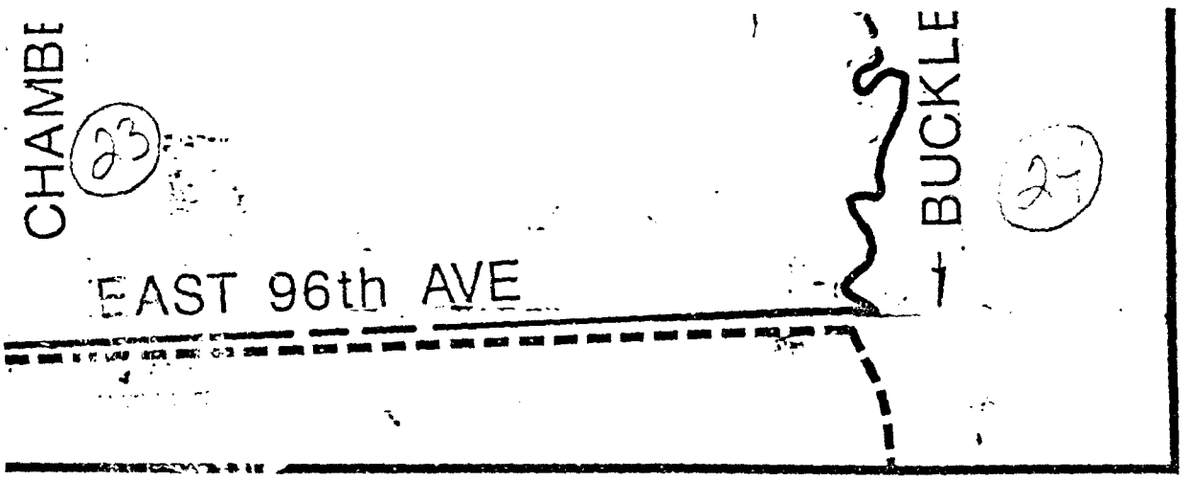
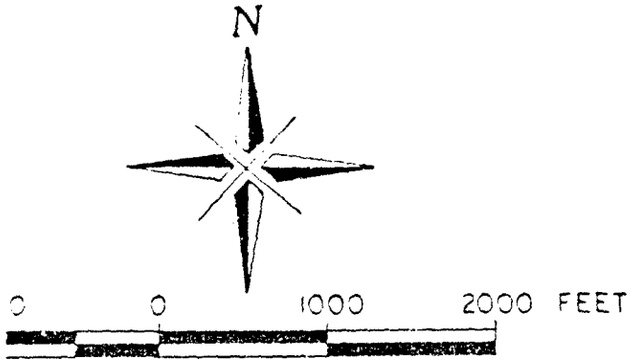
	STUDY AREA BOUNDARY



unty Health Department

ns, Arapahoe and Douglas Counties



LEGEND

.UVIAL WELLS

KNOWN AQUIFER WELLS

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MBER FOR PROPERTY

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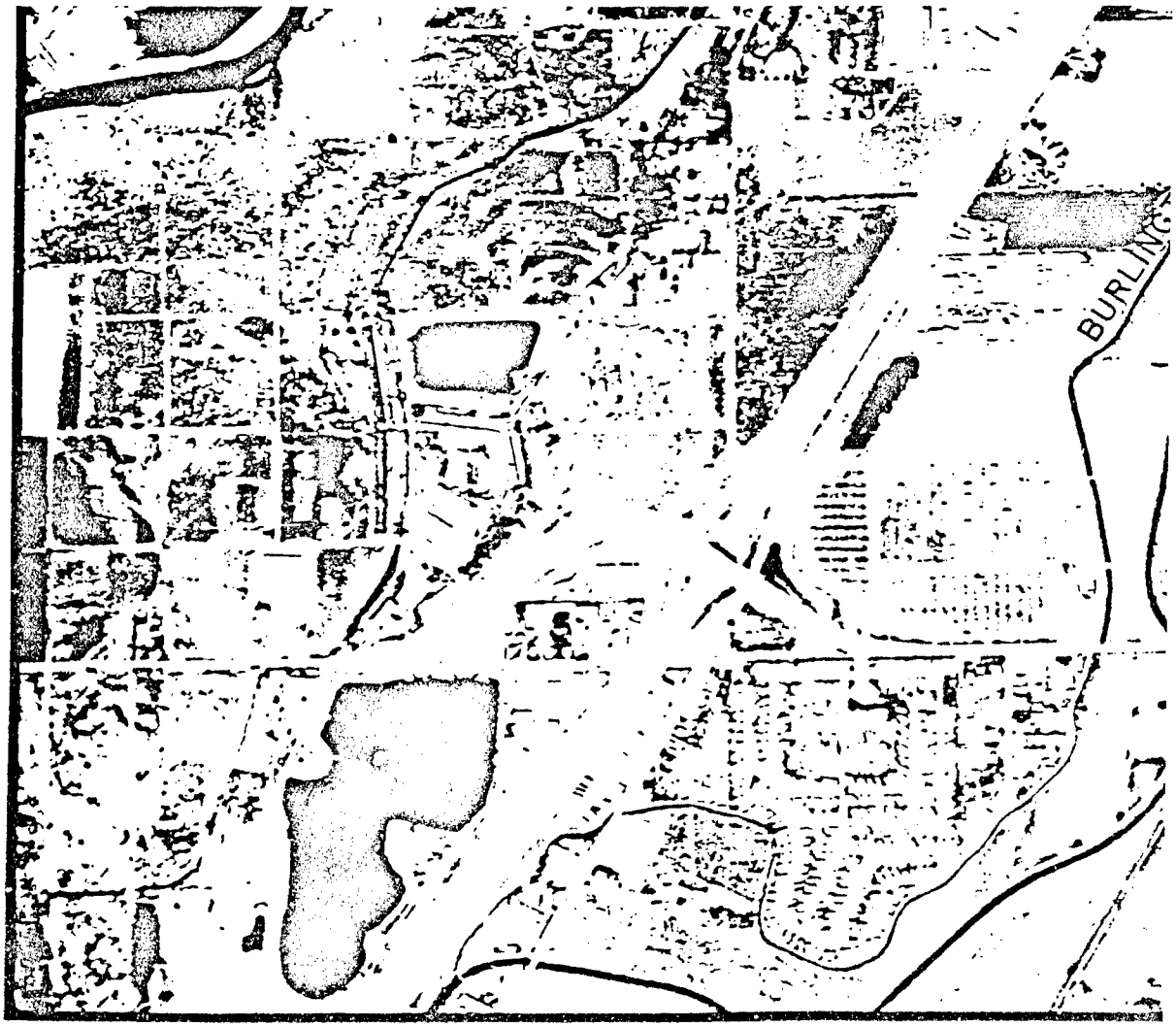

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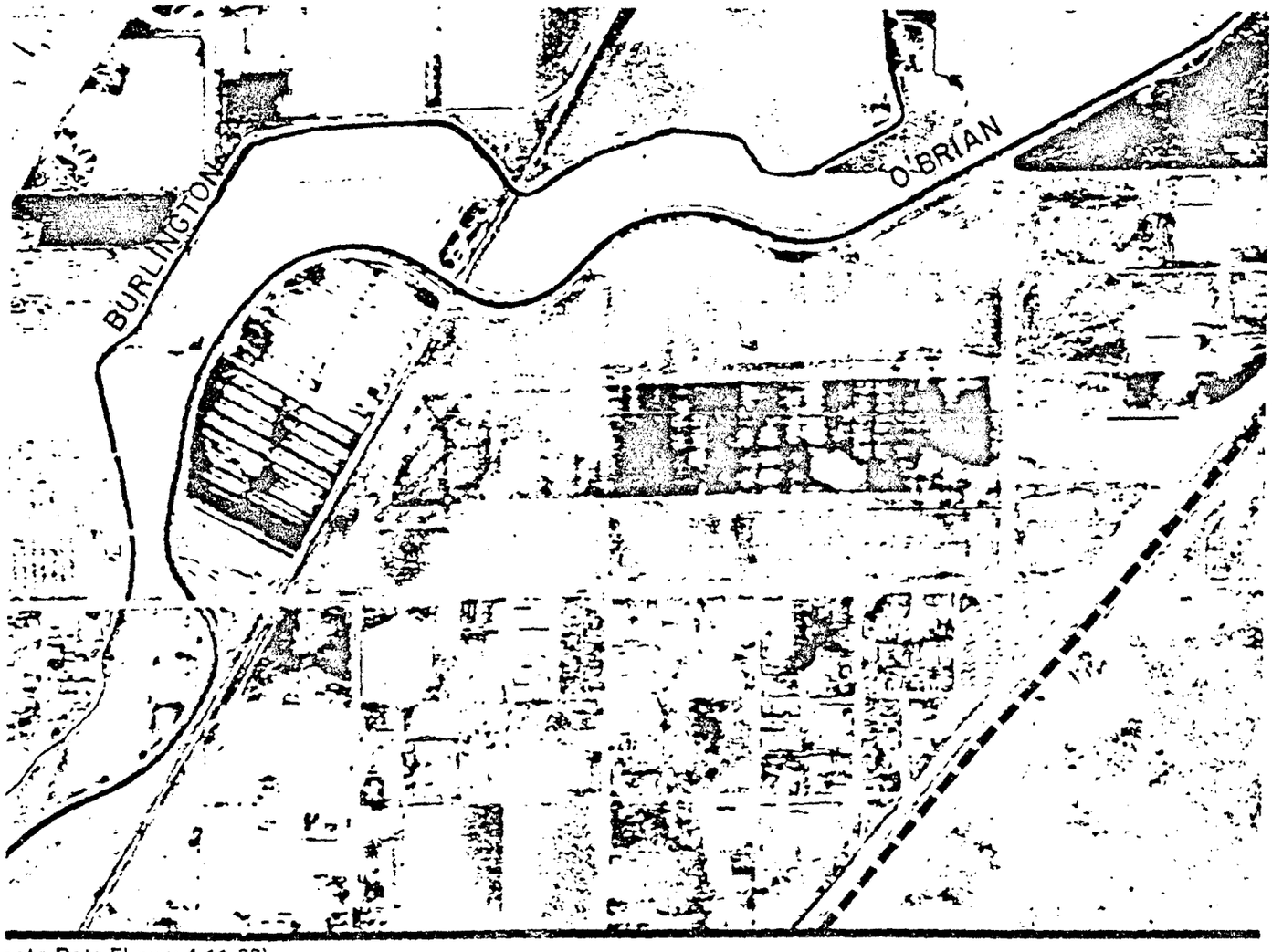

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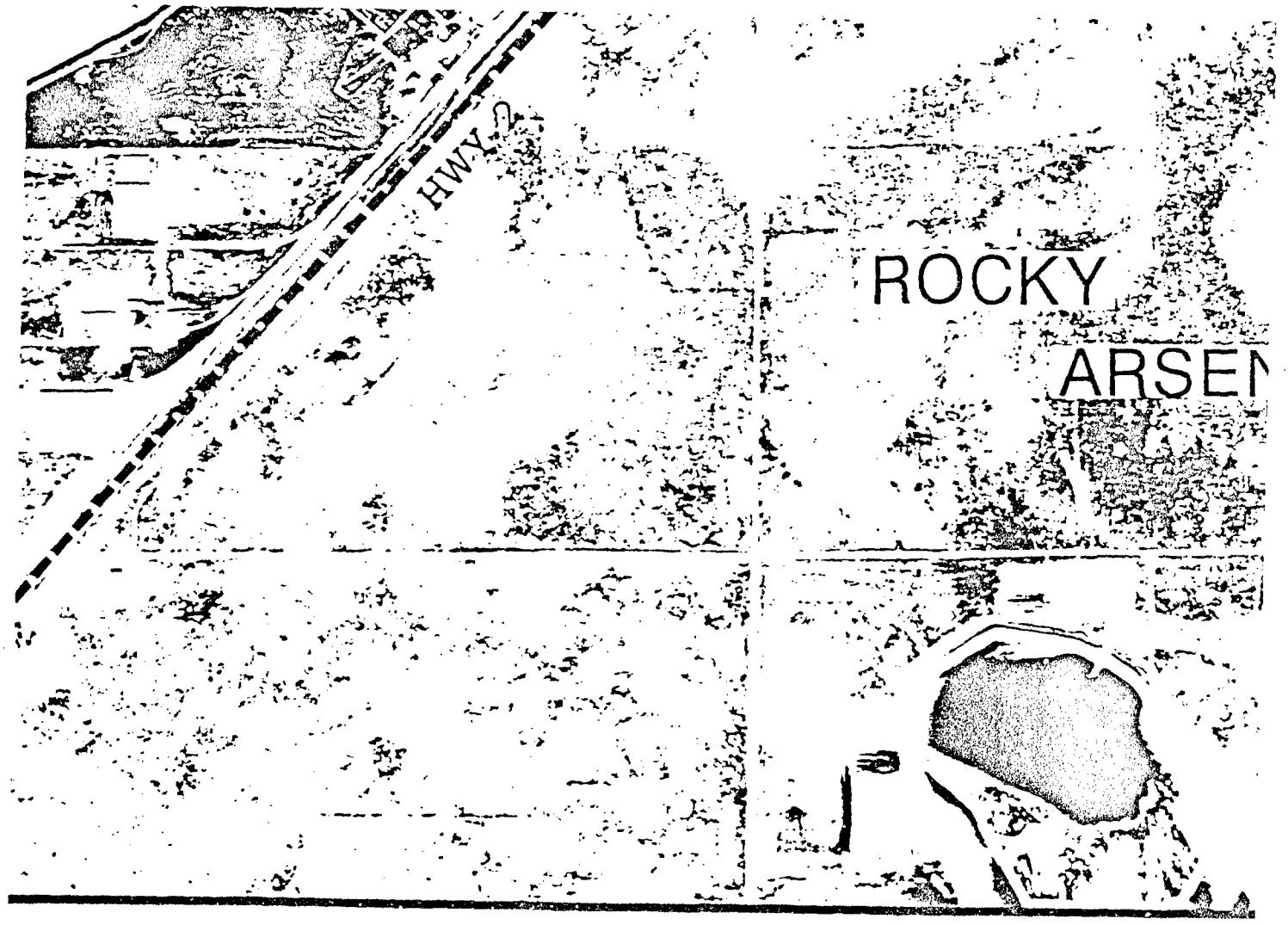

NKNOWN AQUIFER WELI
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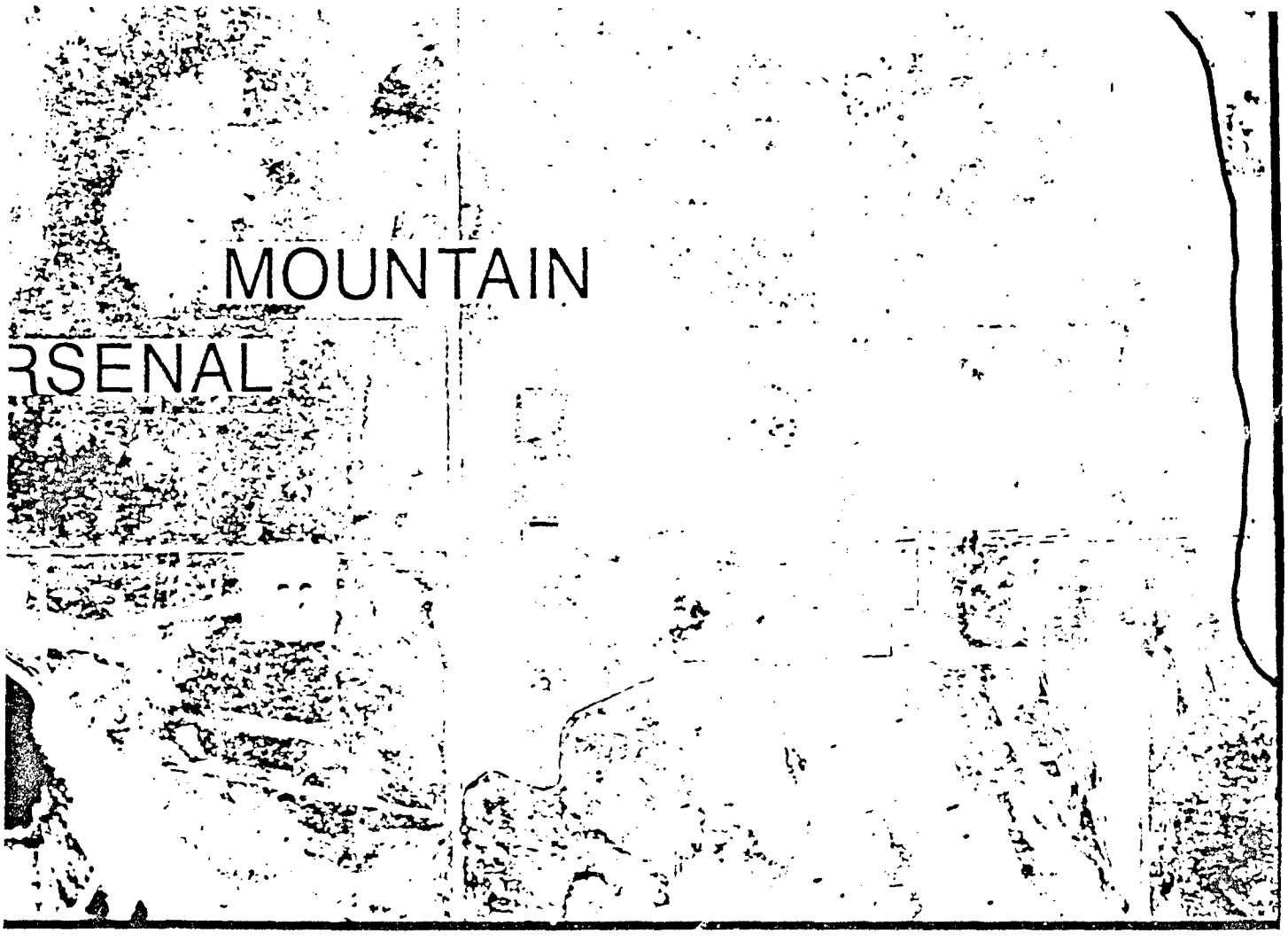

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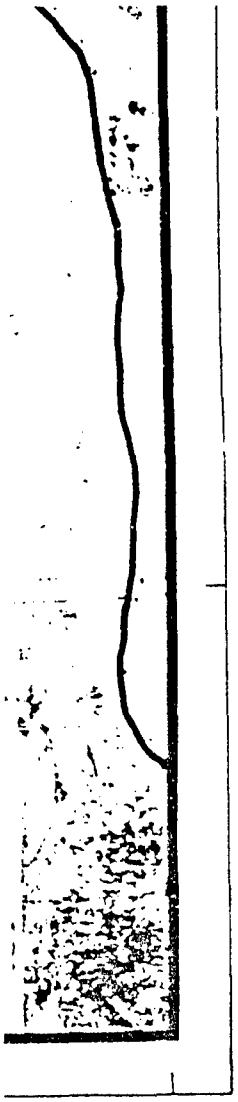
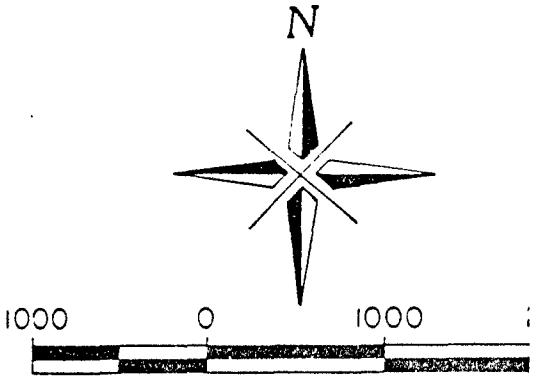


Tri County Healt
Serving Adams, Arapahoe and Do



LEGEND

▲	ALLUVIAL WELLS
■	UNKNOWN AQUIFER WEL
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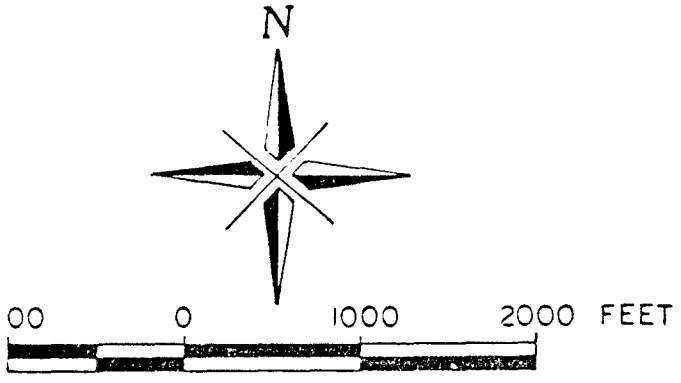
unty Health Department

ms, Arapahoe and Douglas Counties



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LUVIAL WELLS

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)MPUTER IDENTIFICATION
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IA BOUNDARY

CTION NUMBER OF
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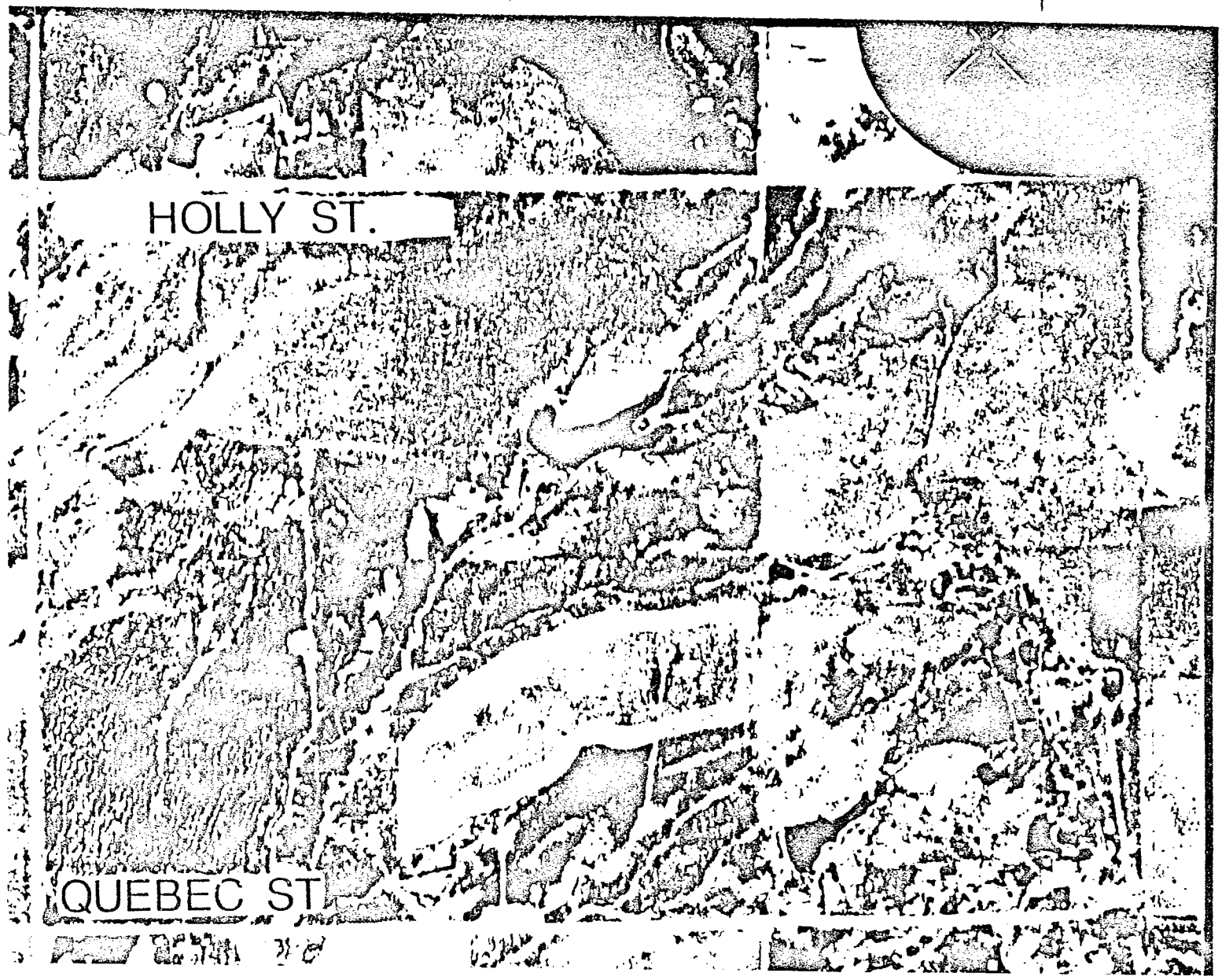
30

DRAWN BY STAN DOOLEY (5-30-89)
REVISED BY MIKE HEYWOOD (2-12-90)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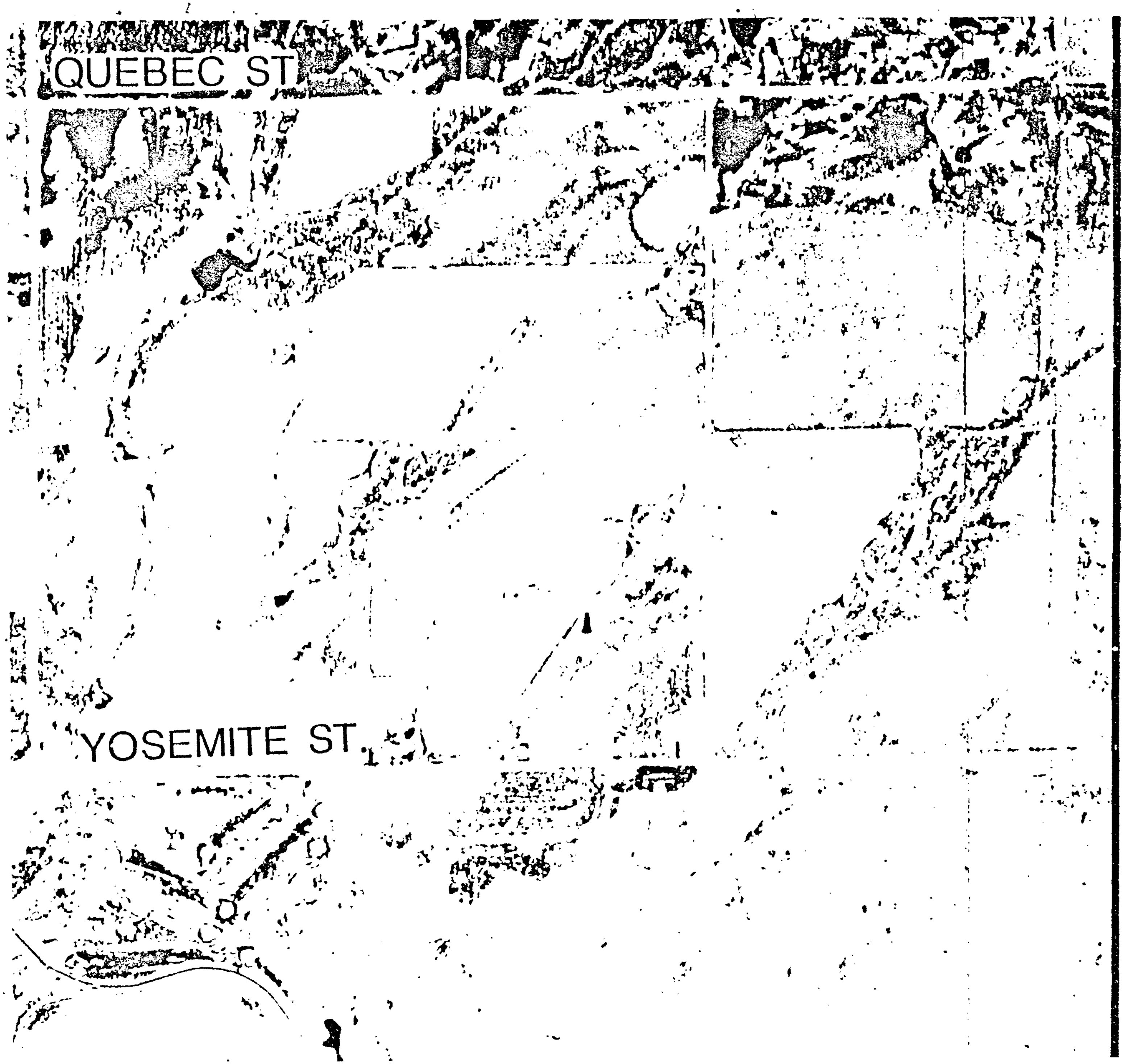

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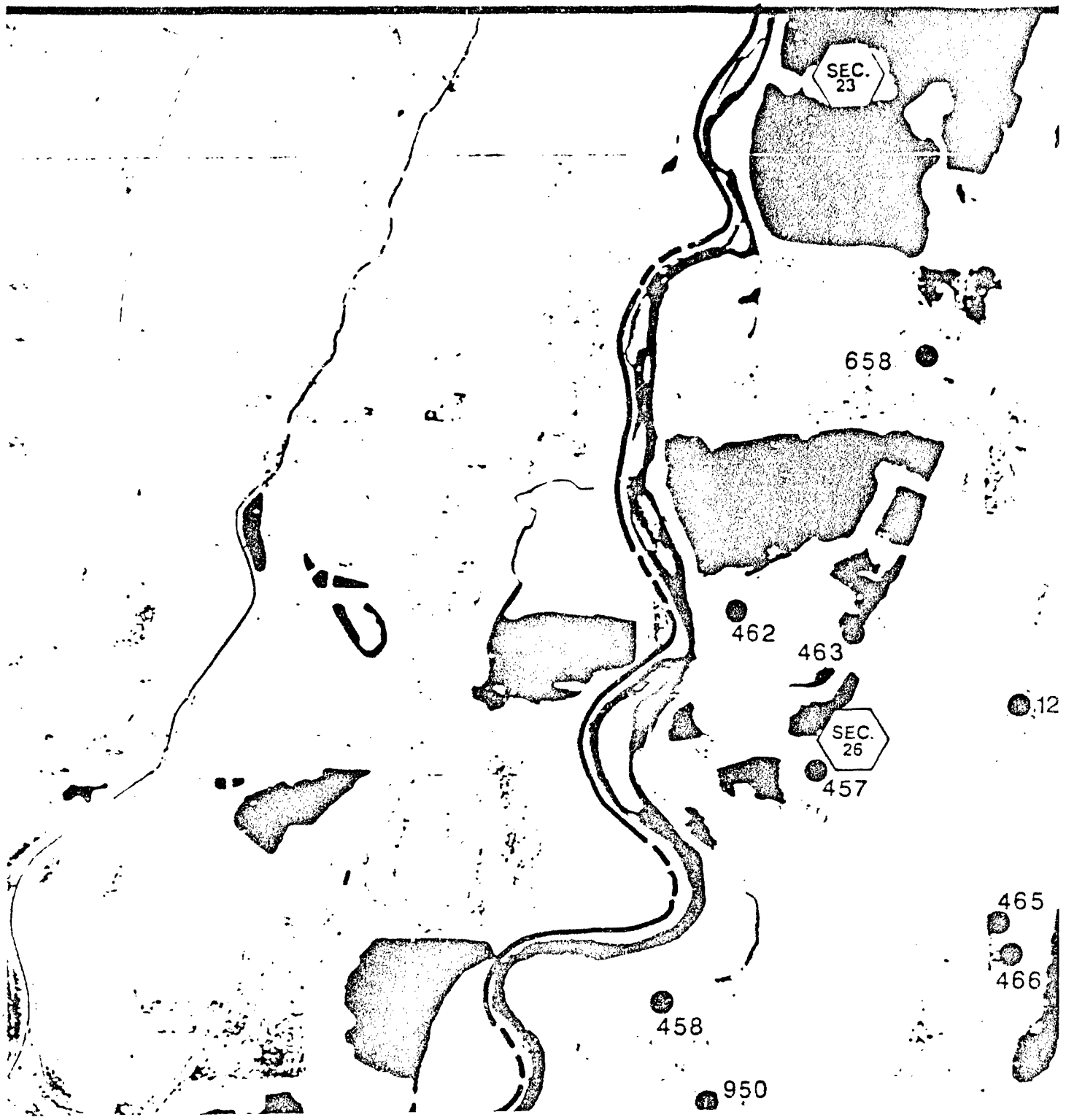
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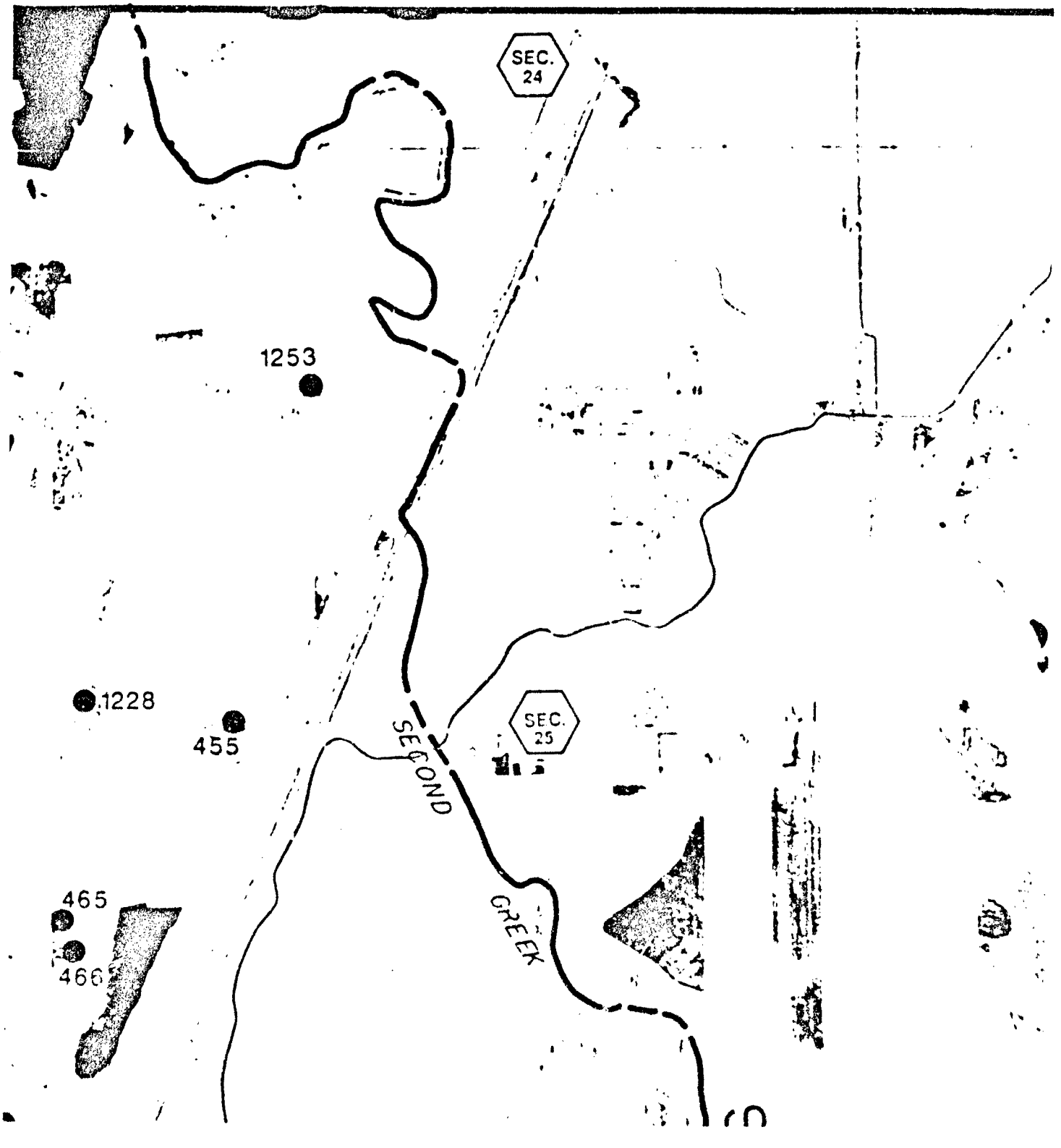
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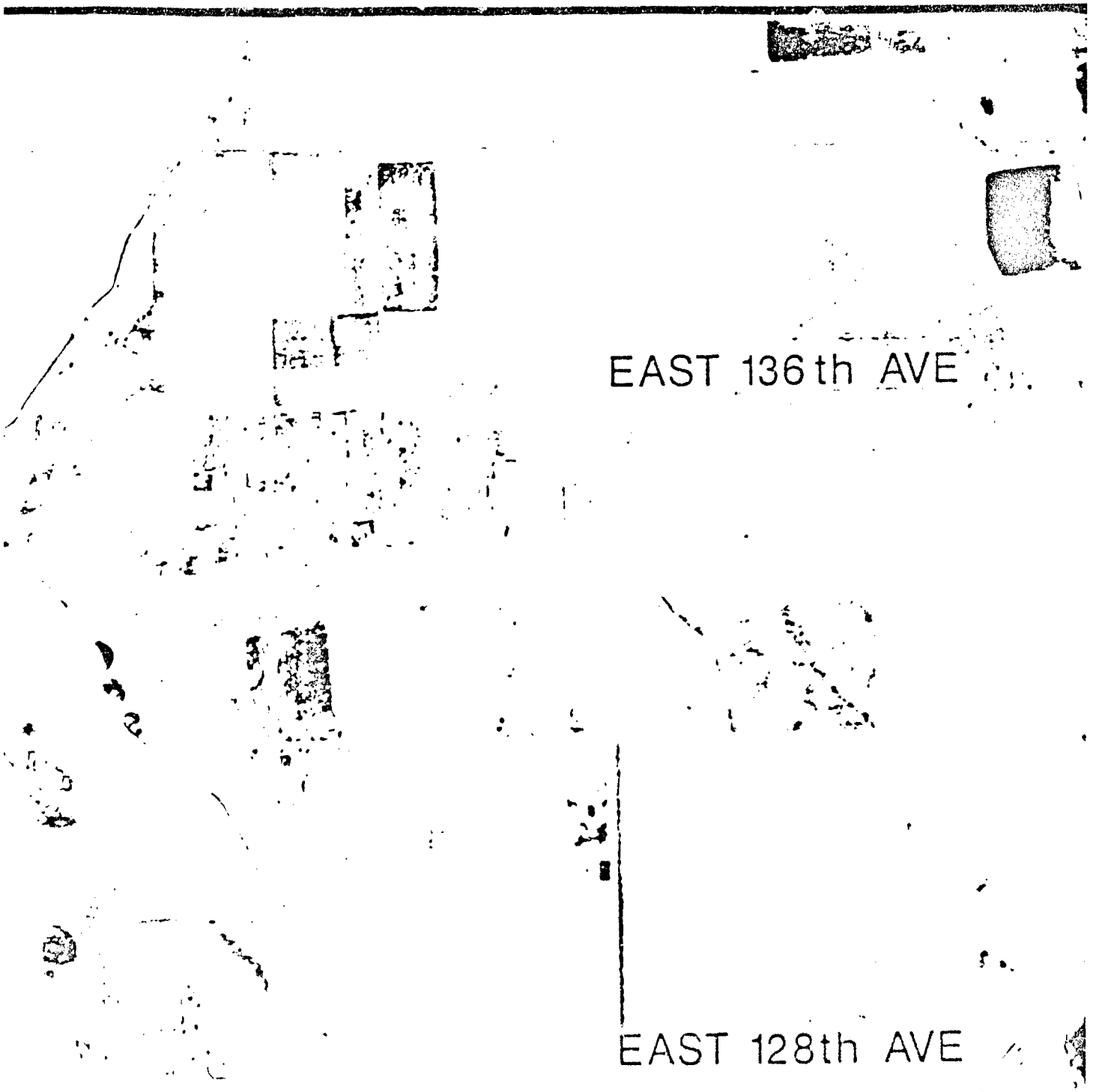

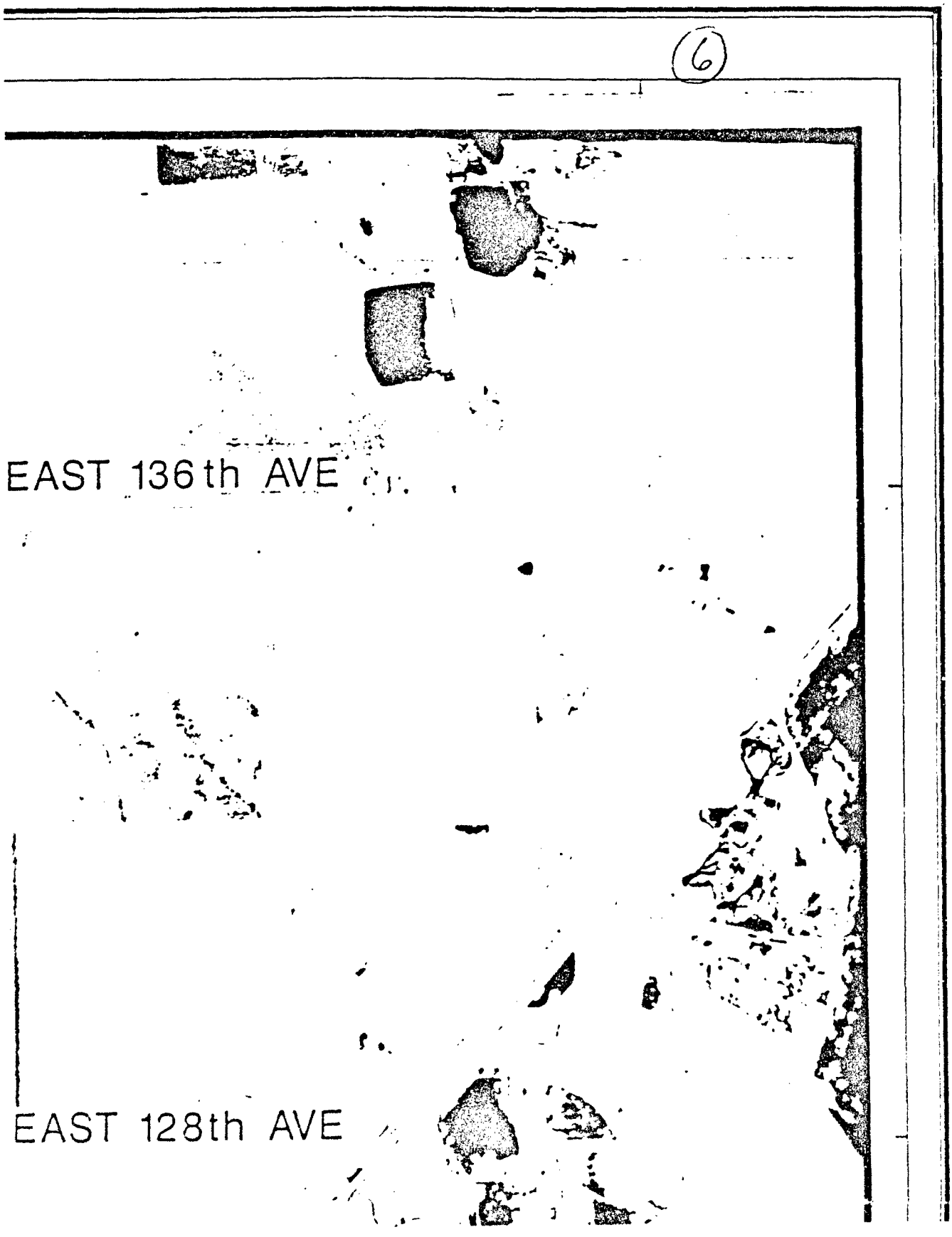
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EAST 136th AVE
EAST 128th AVE


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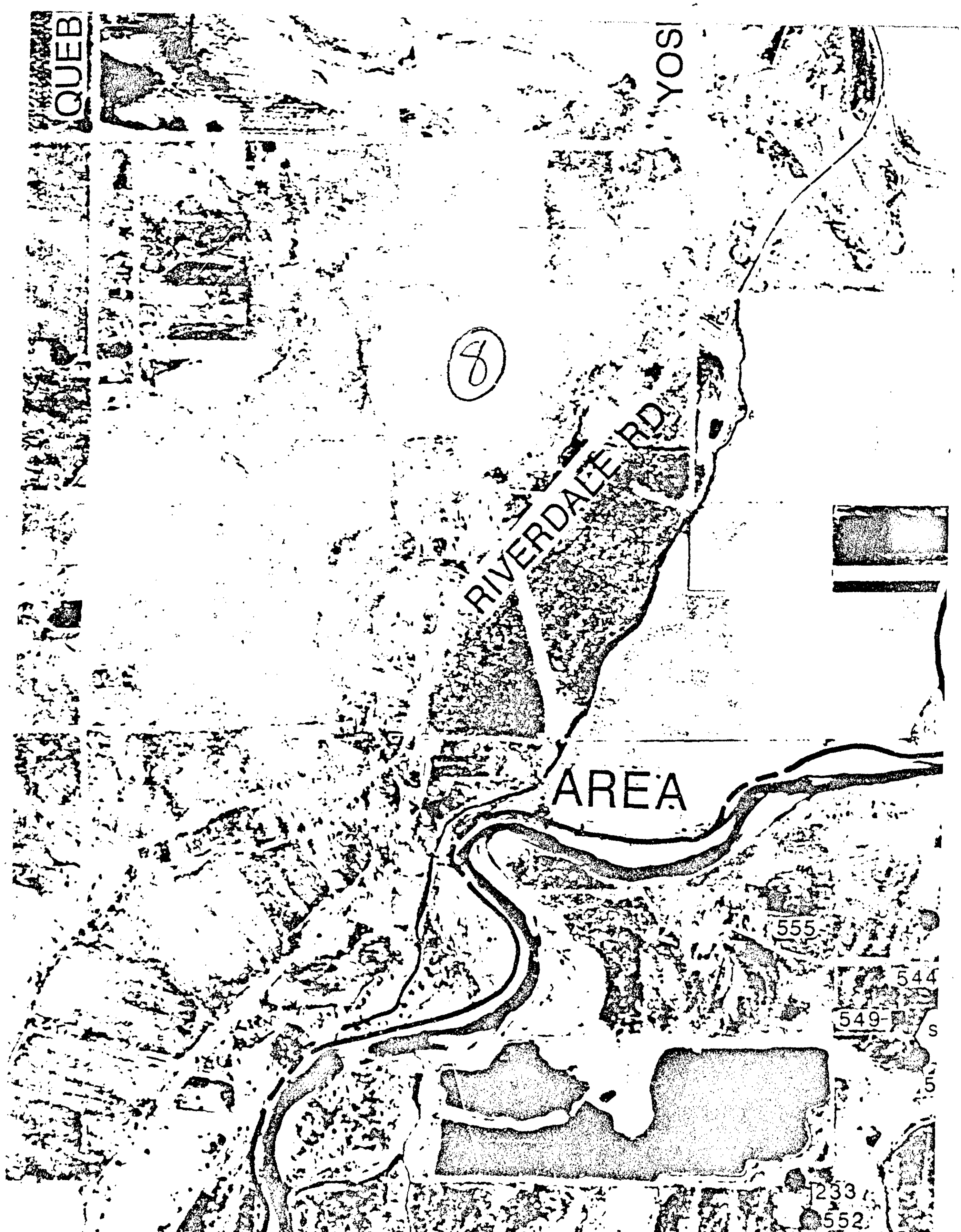
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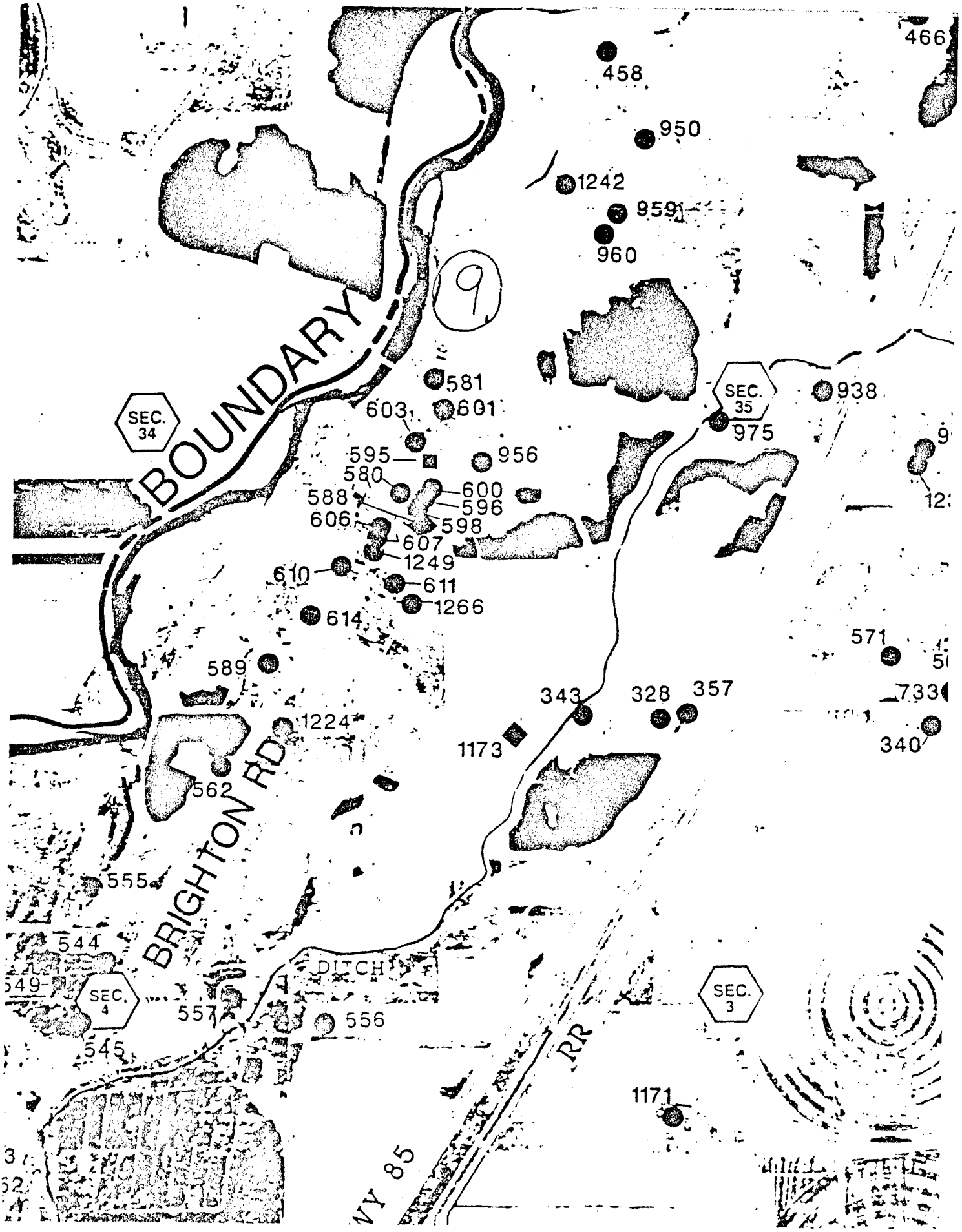
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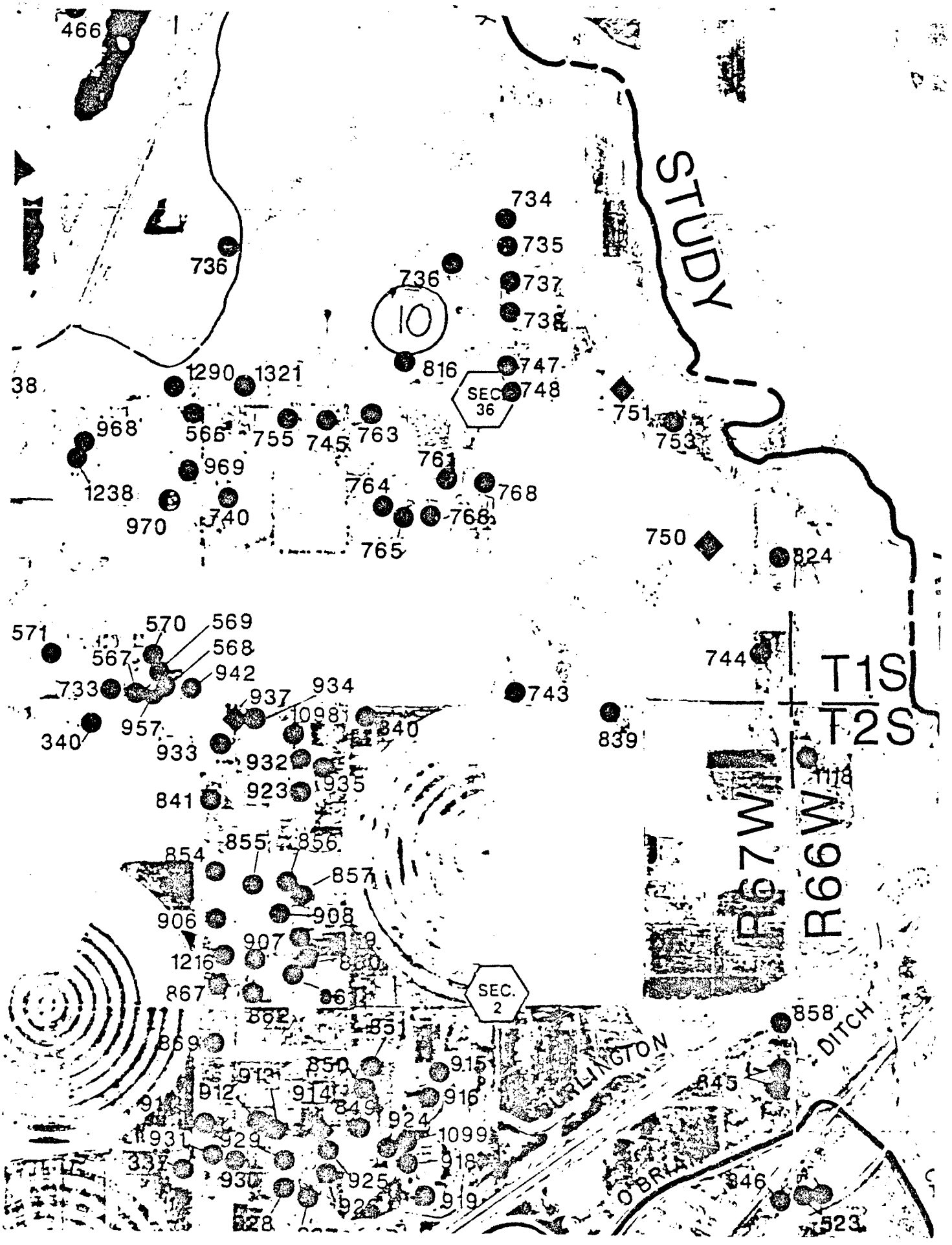
STUDY
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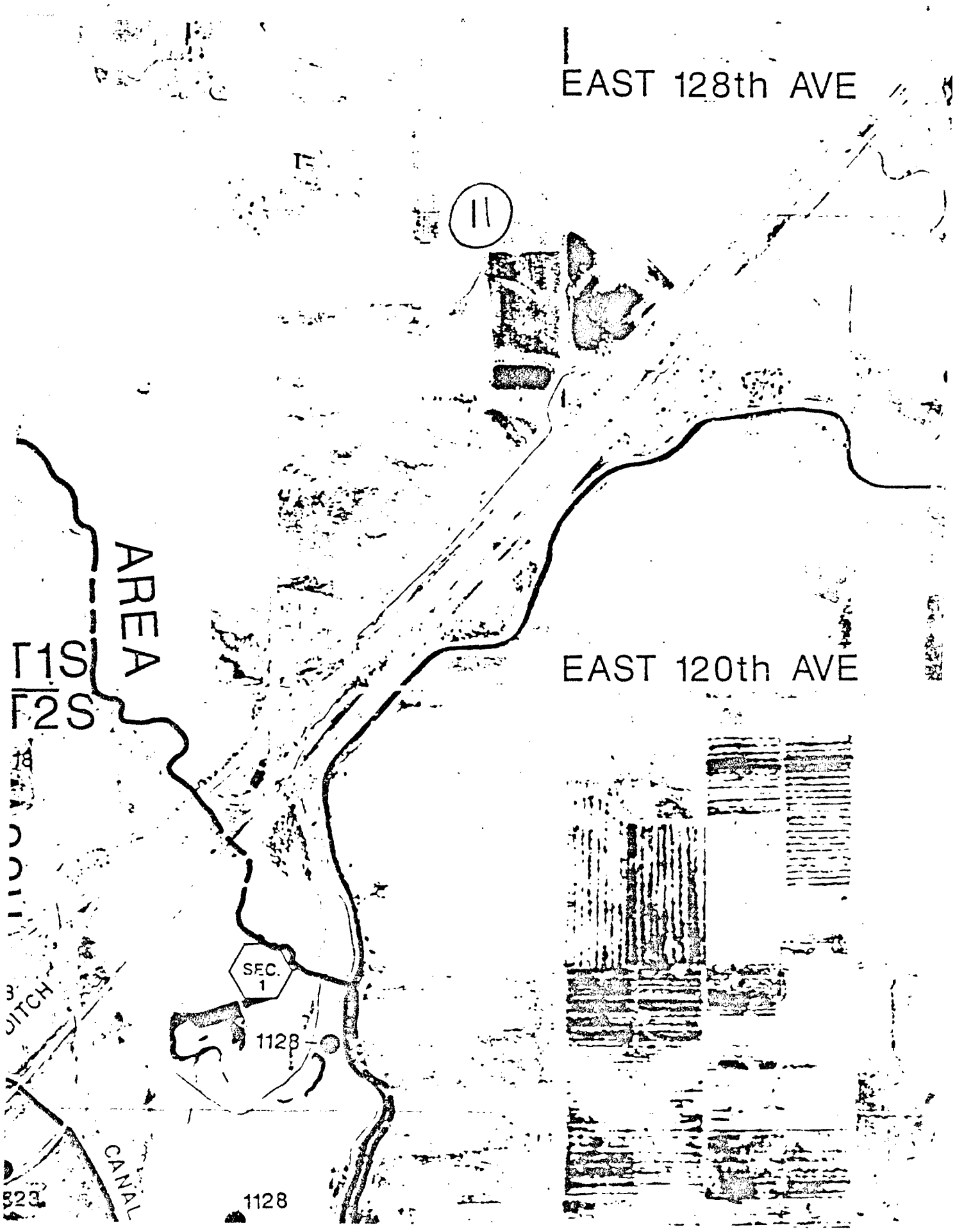
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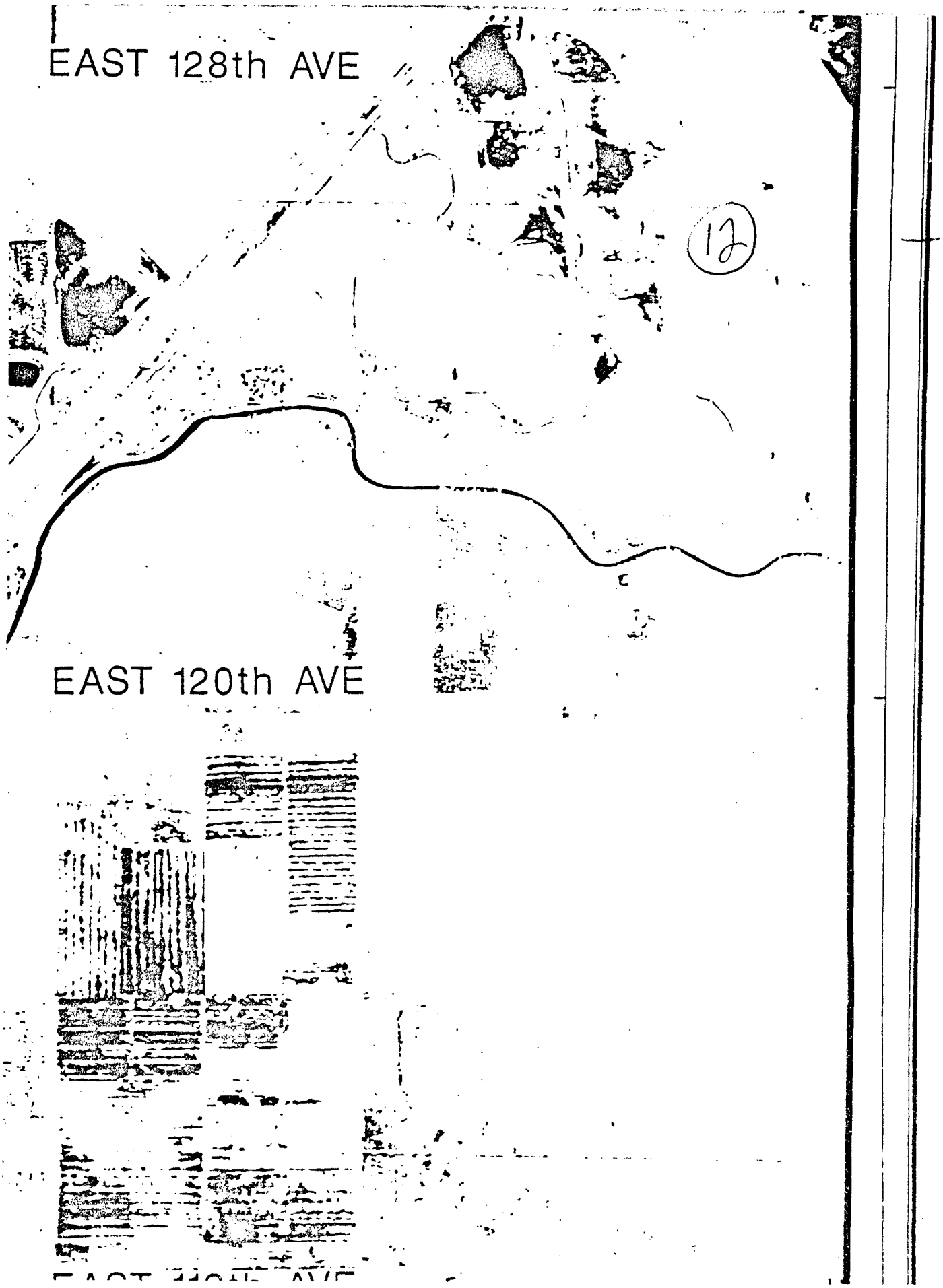
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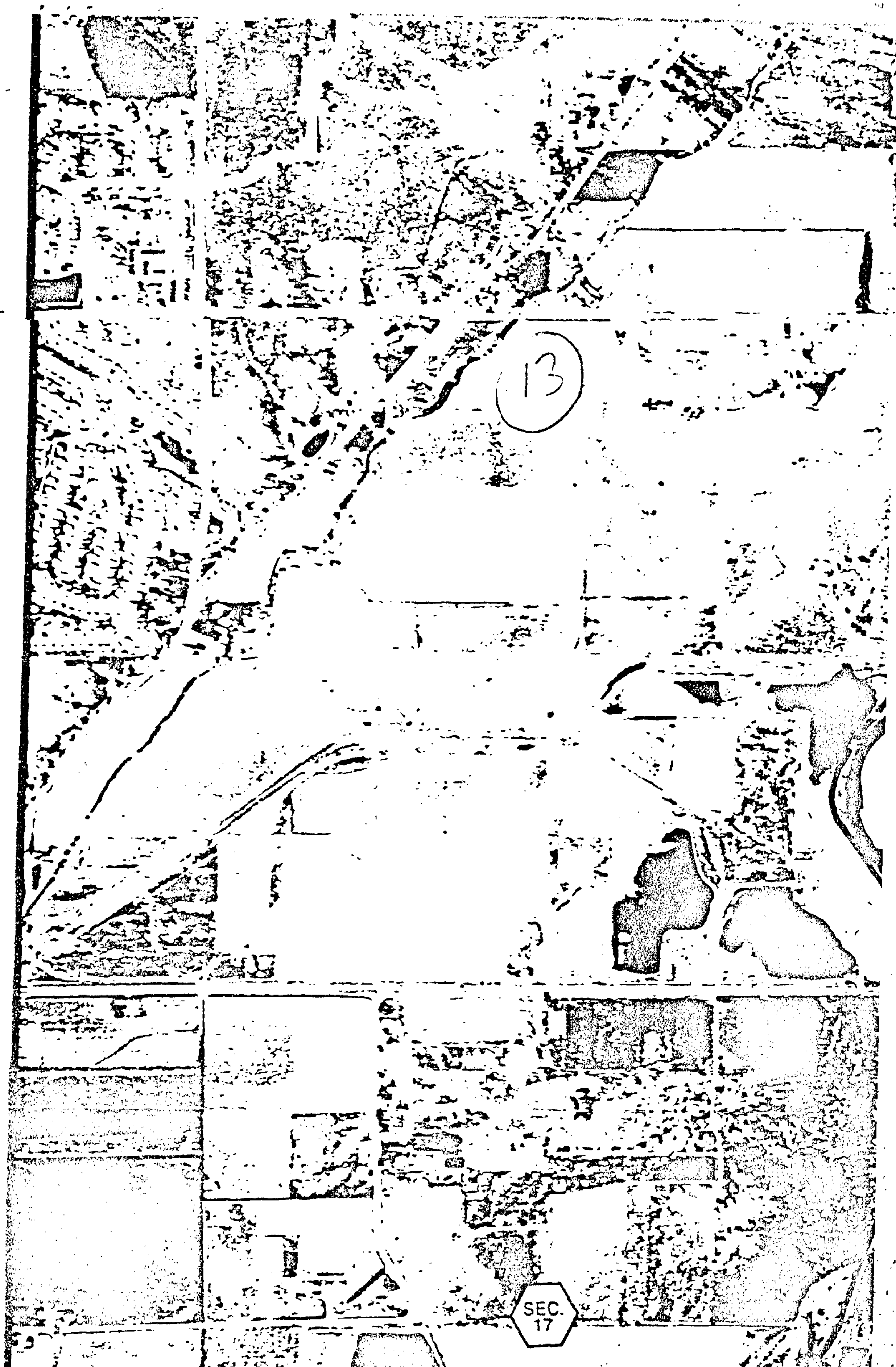
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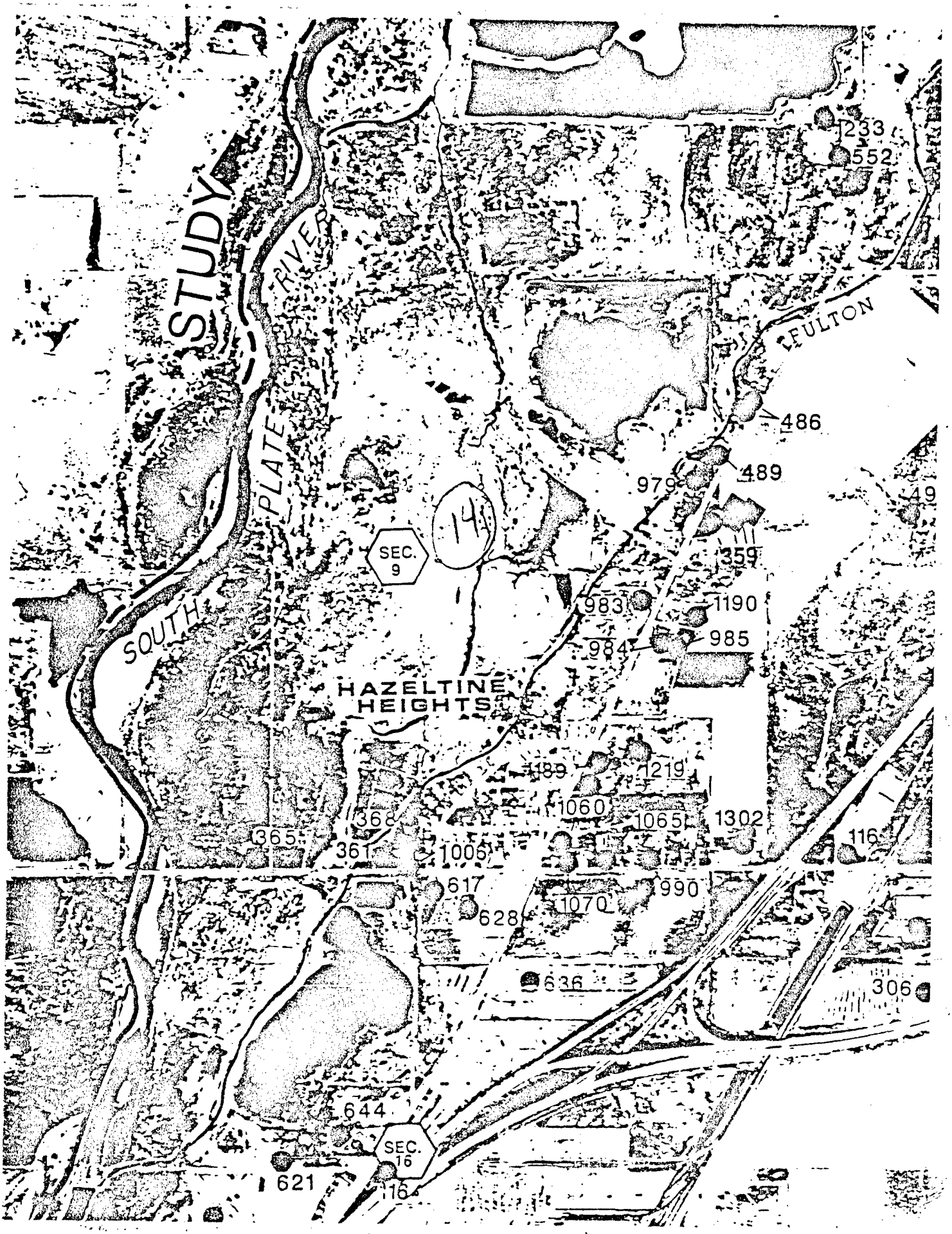
STUDY
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FULTON
HAZELTINE HEIGHTS
SEC. 9
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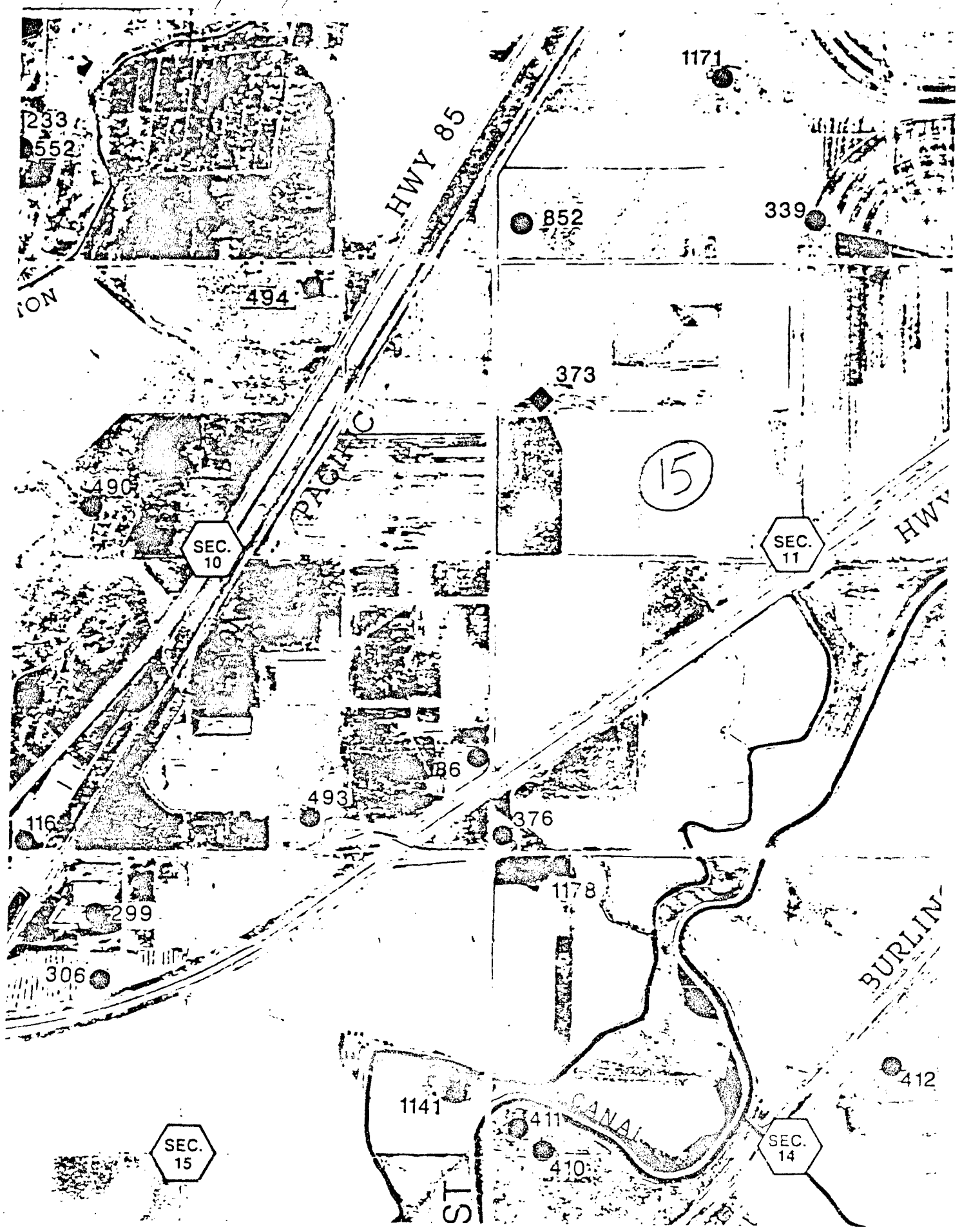
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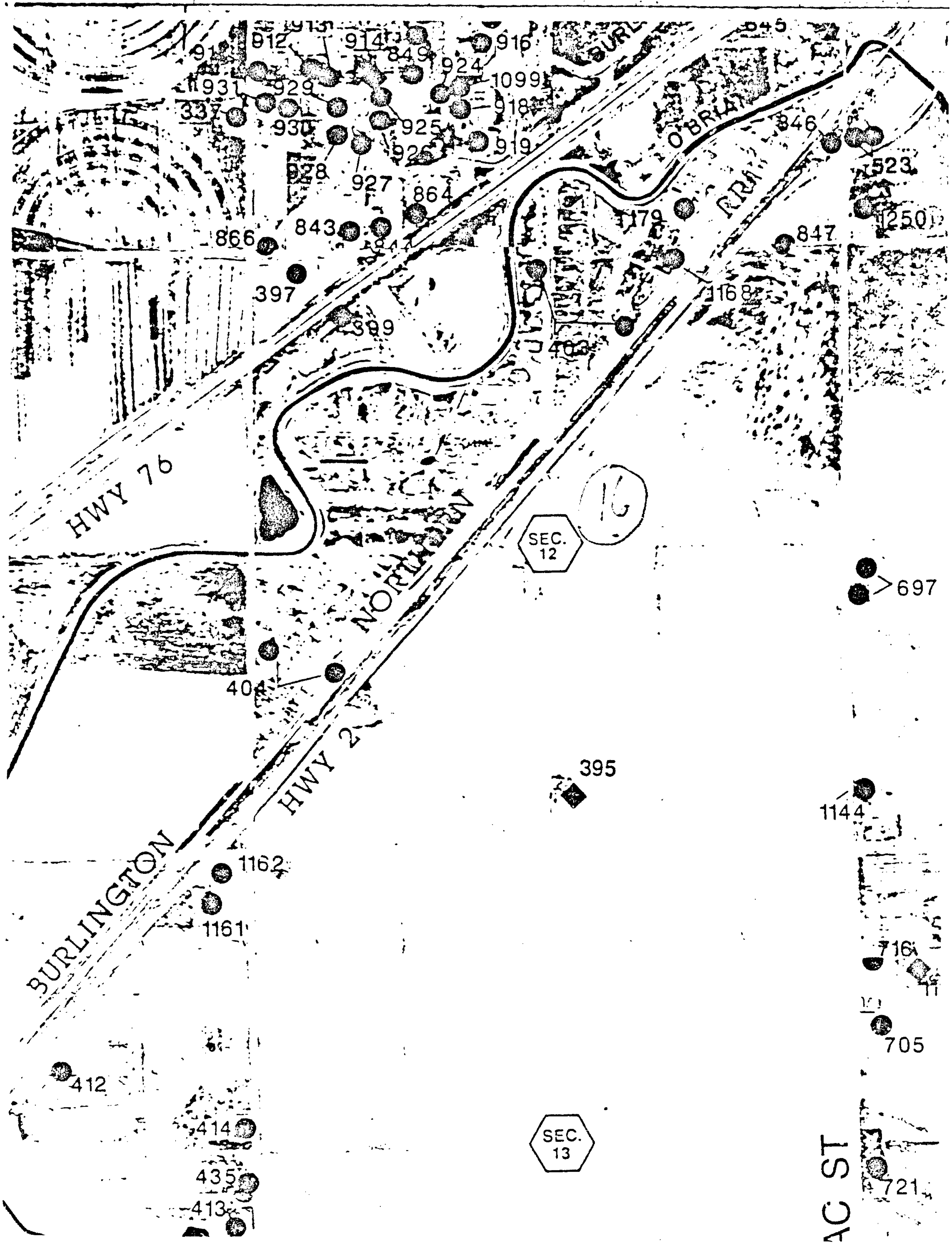
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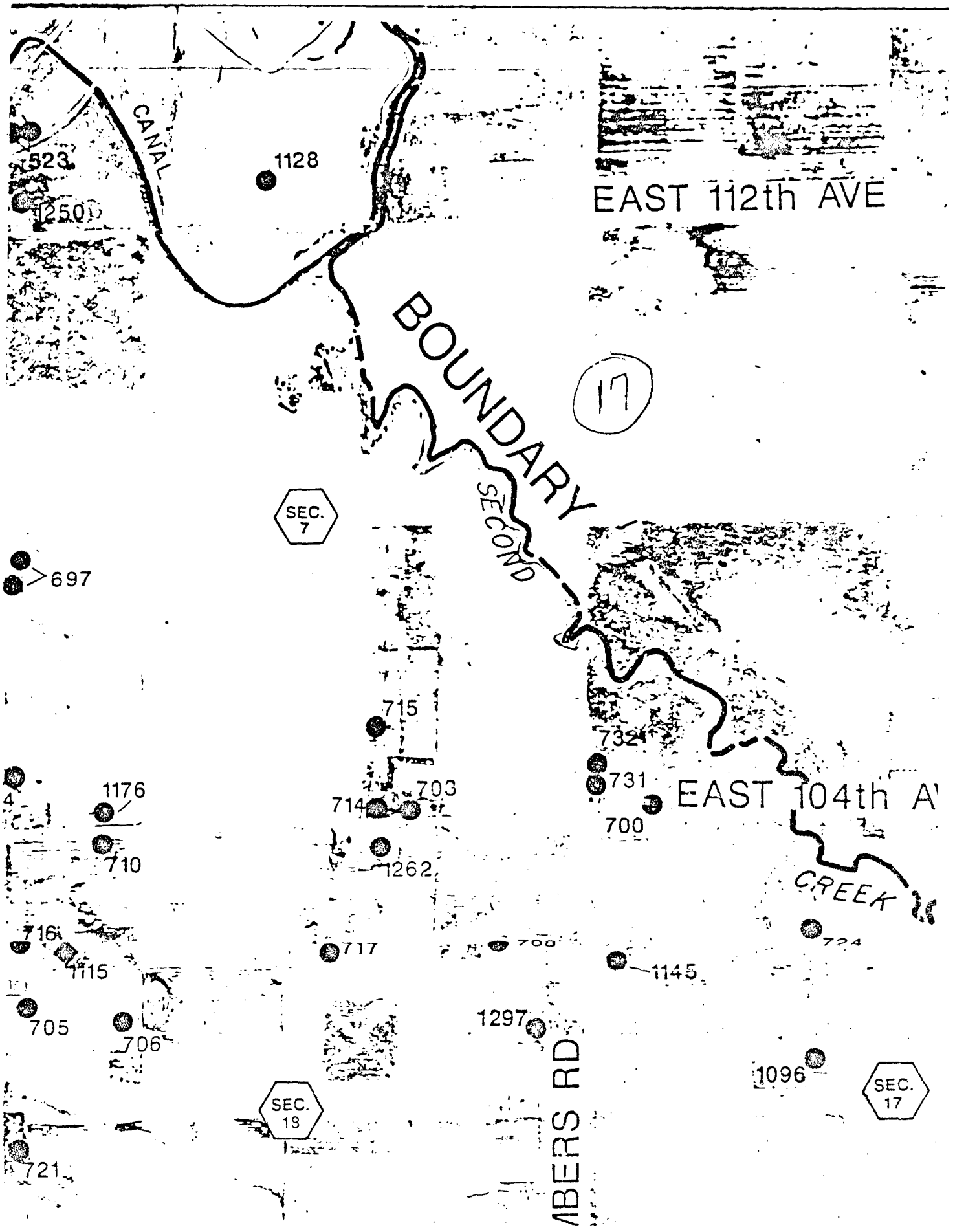
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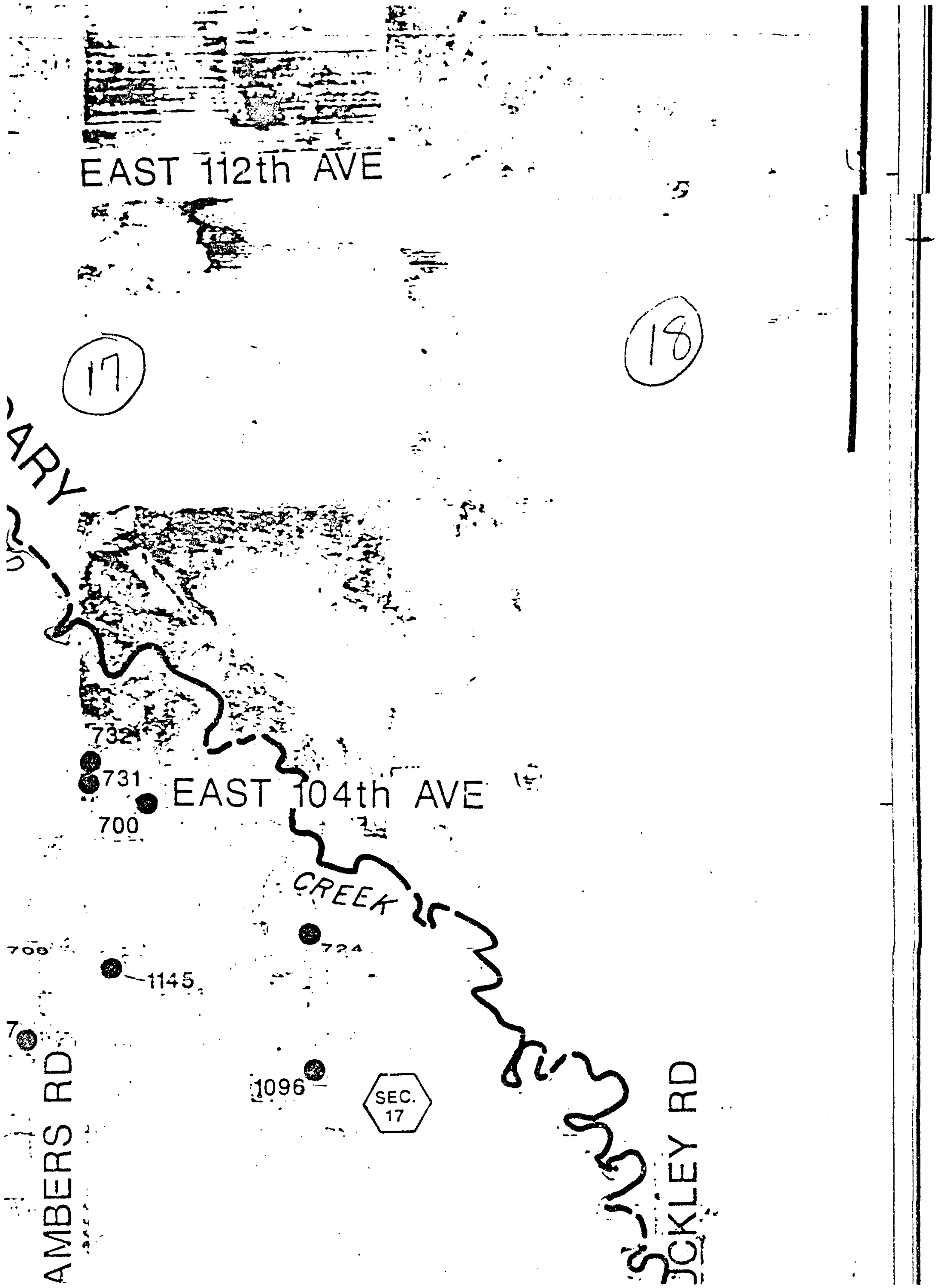
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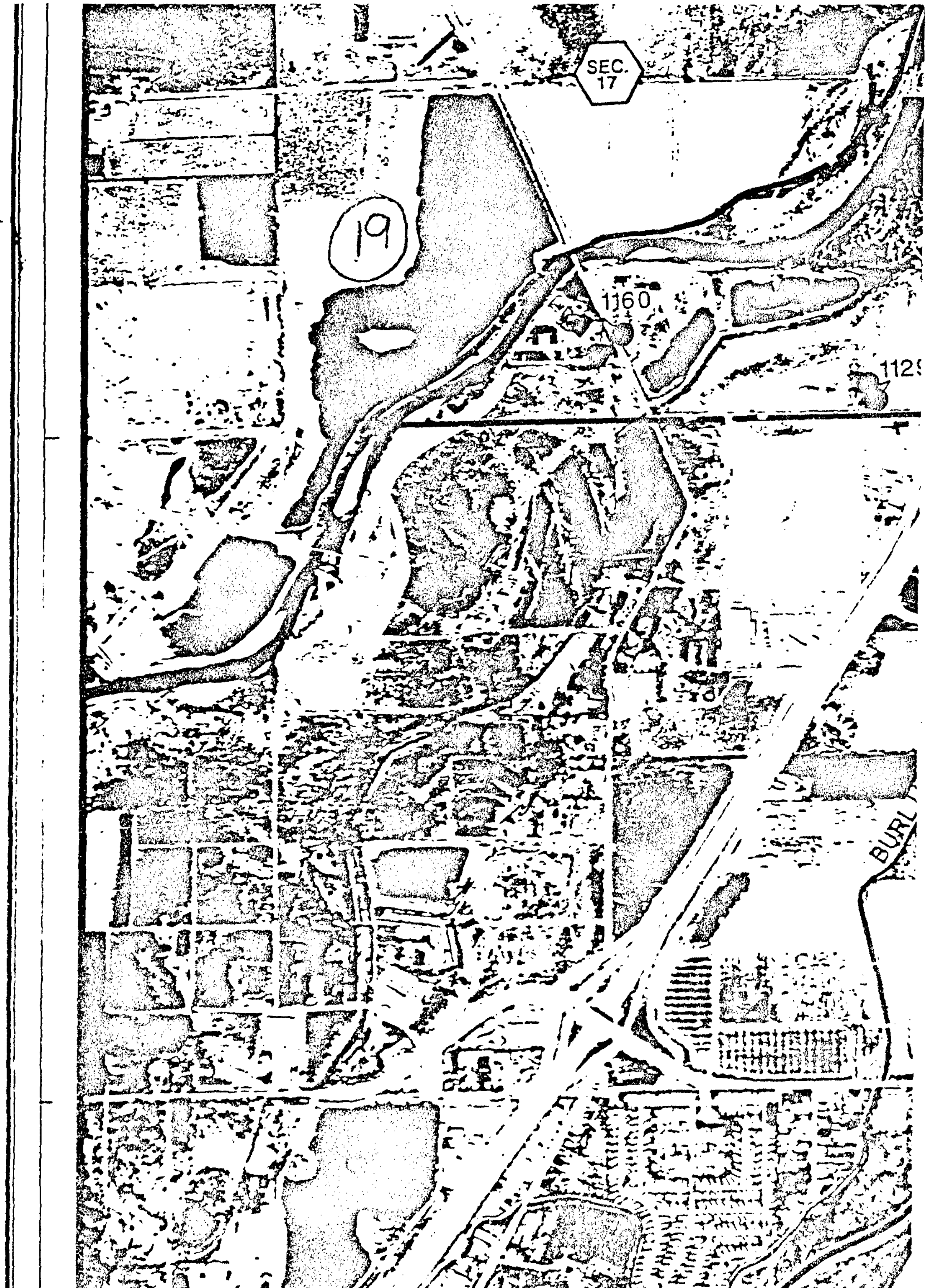
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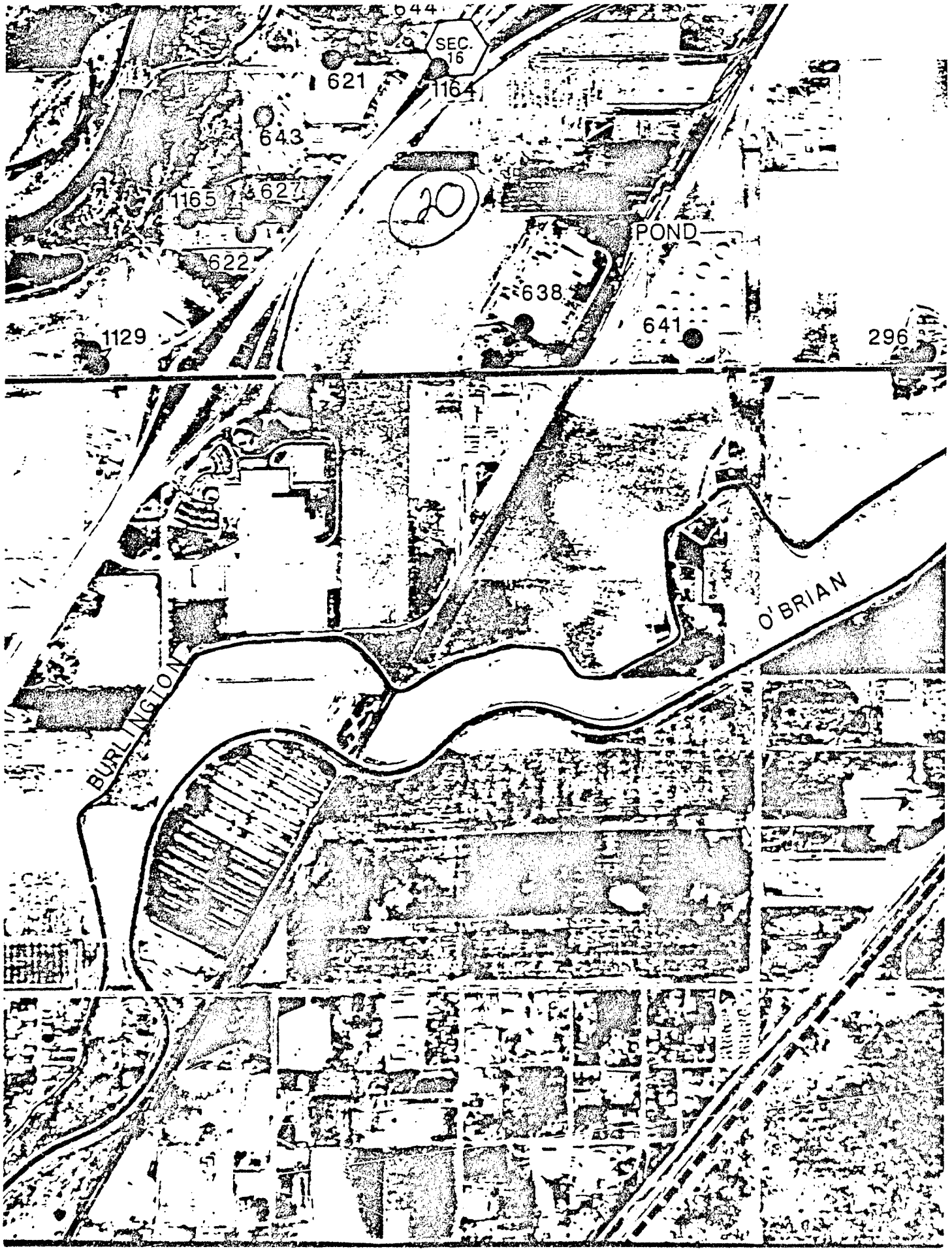
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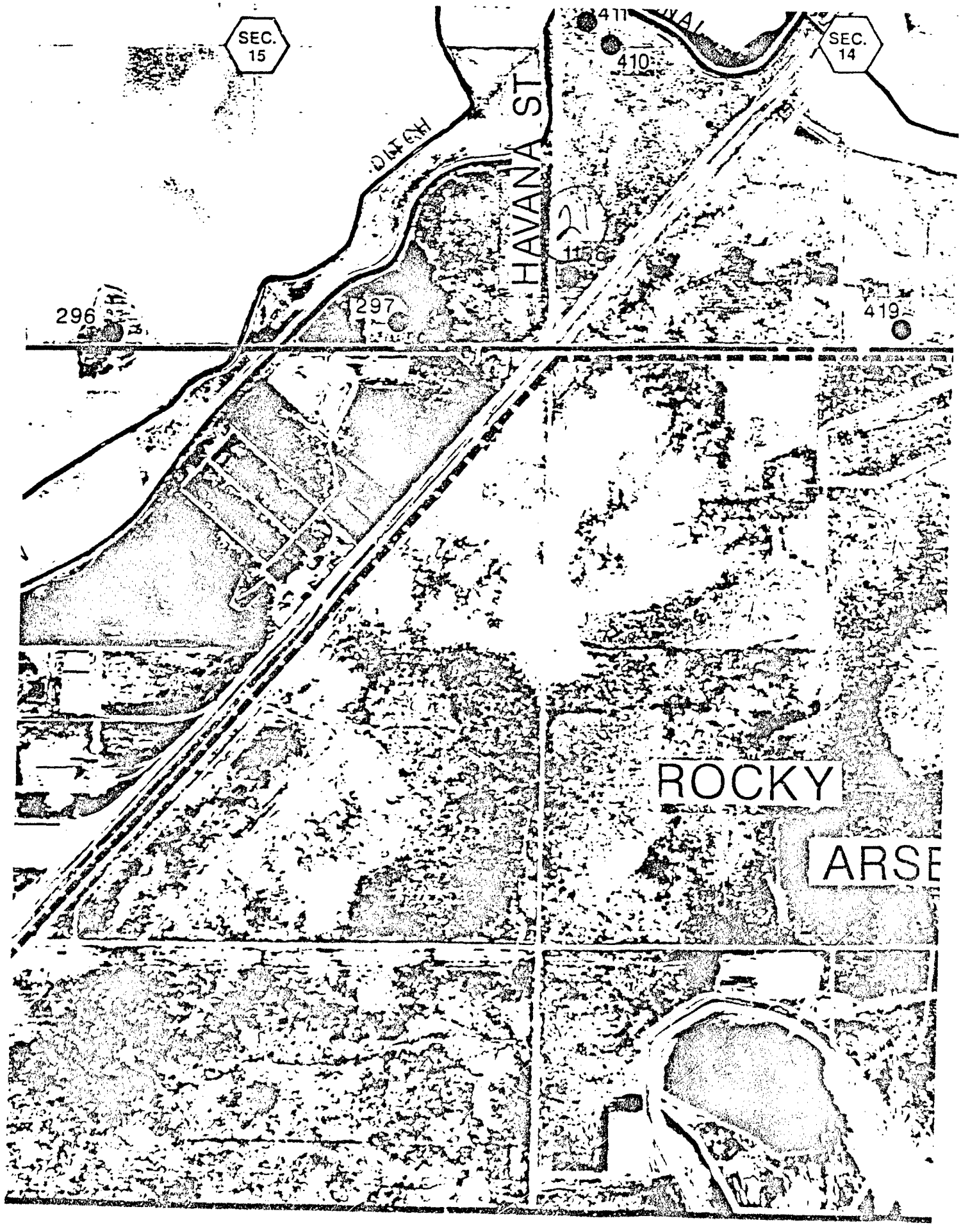
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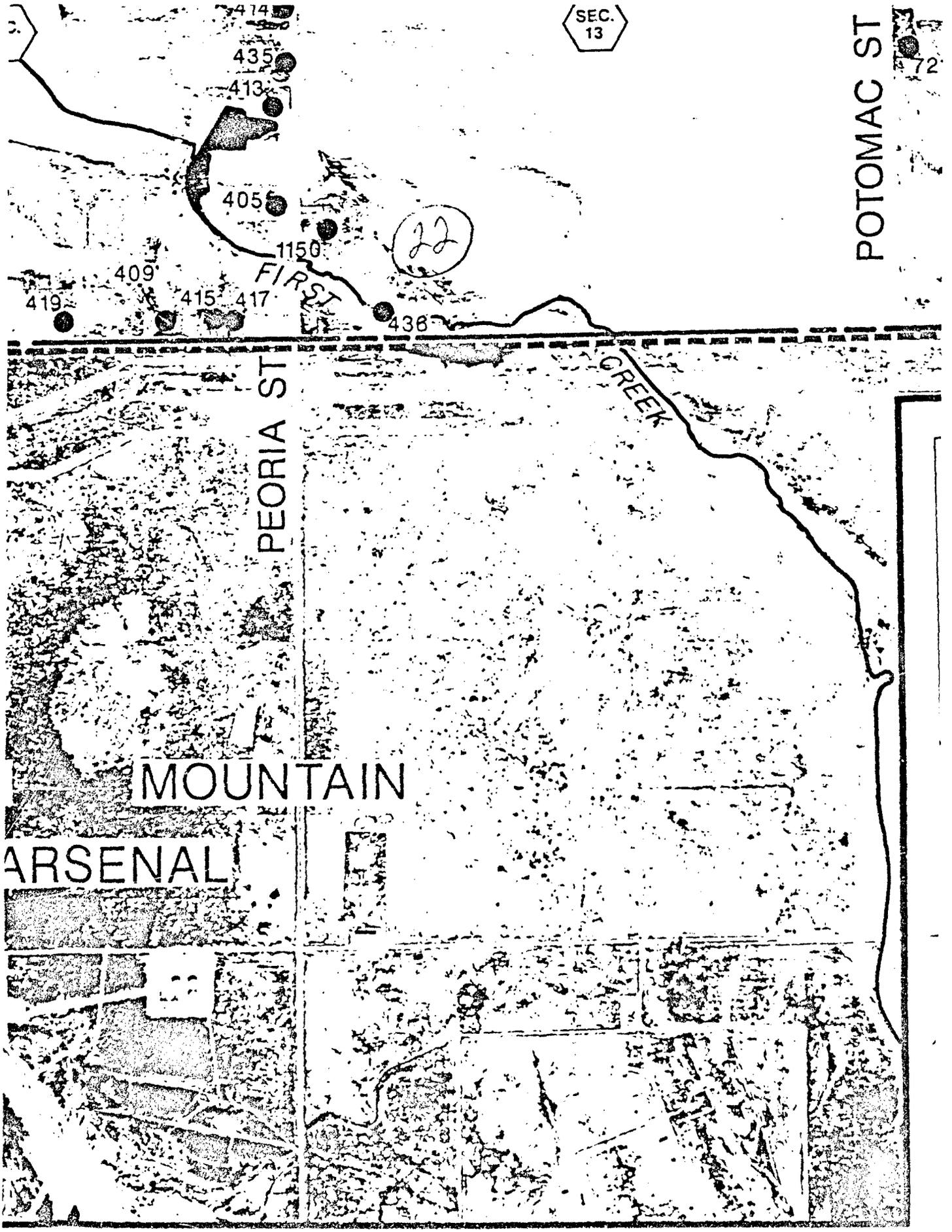
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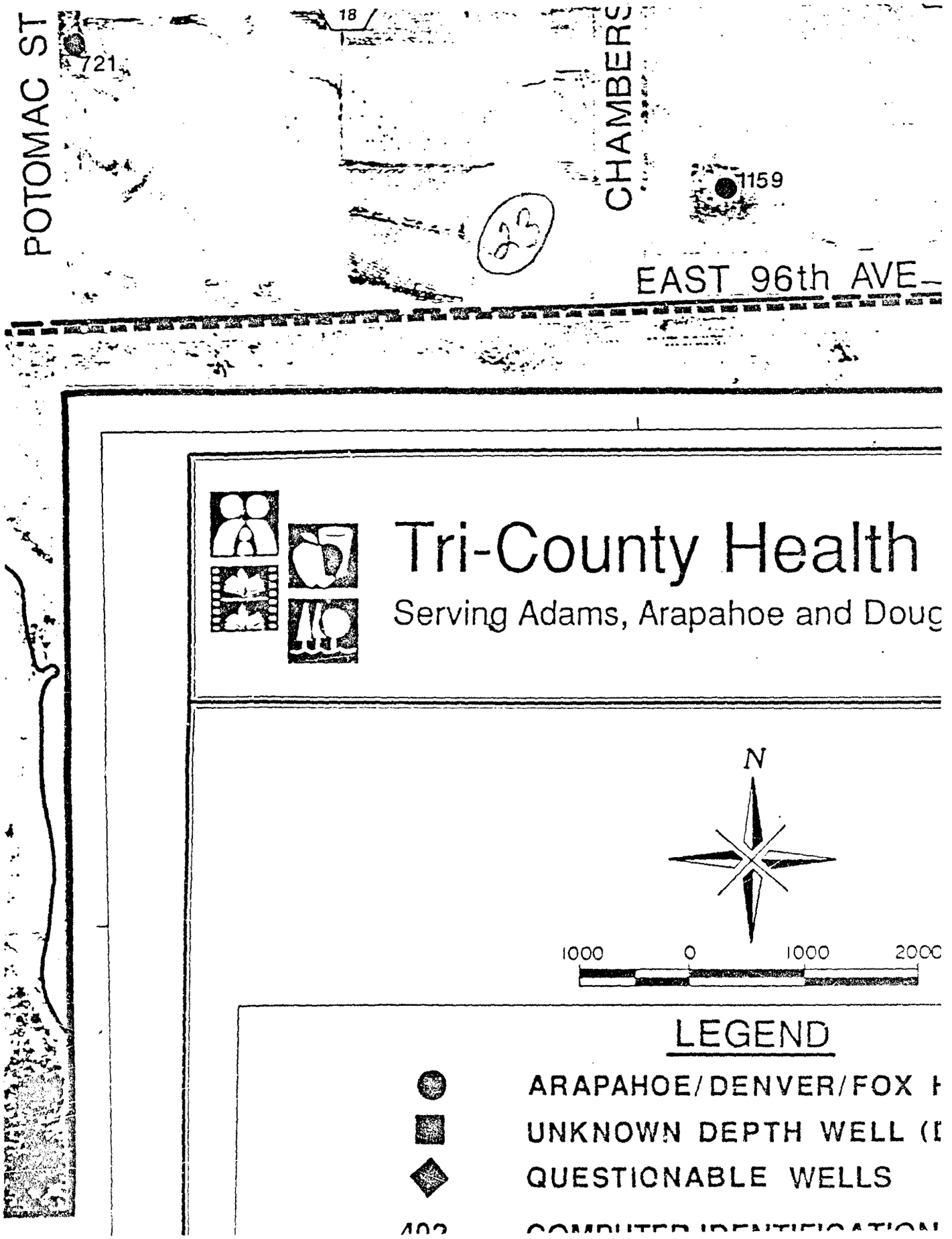
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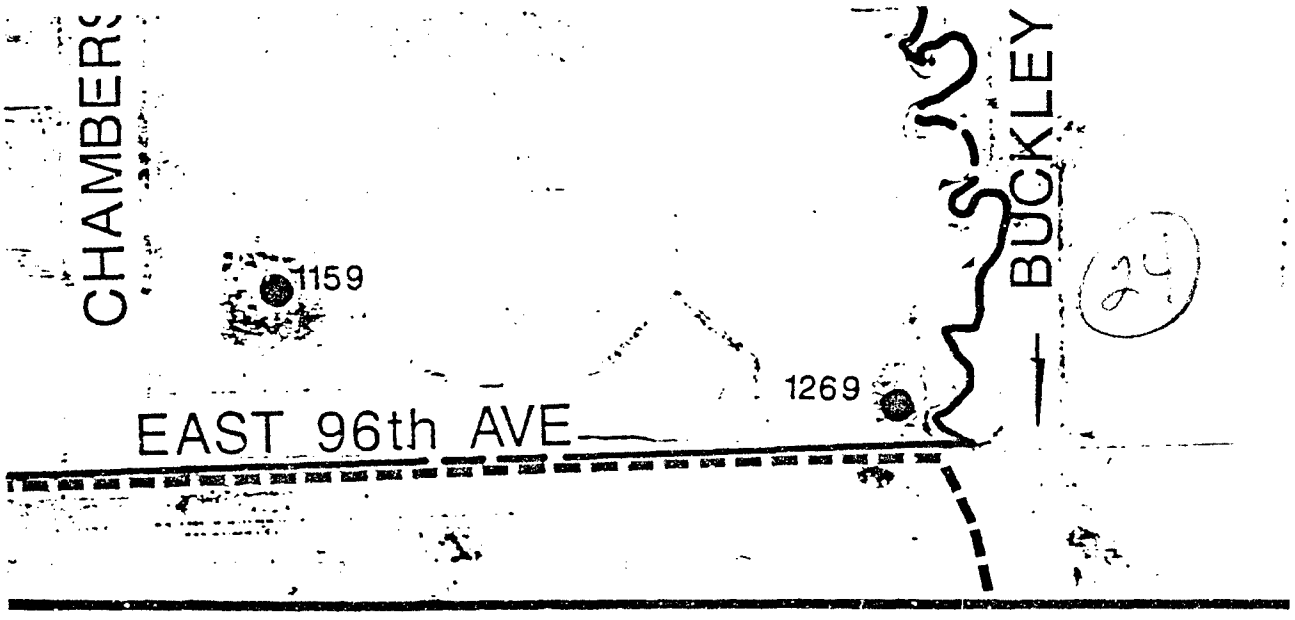

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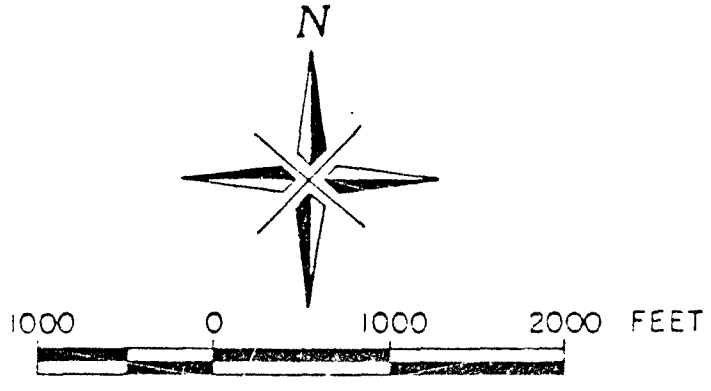

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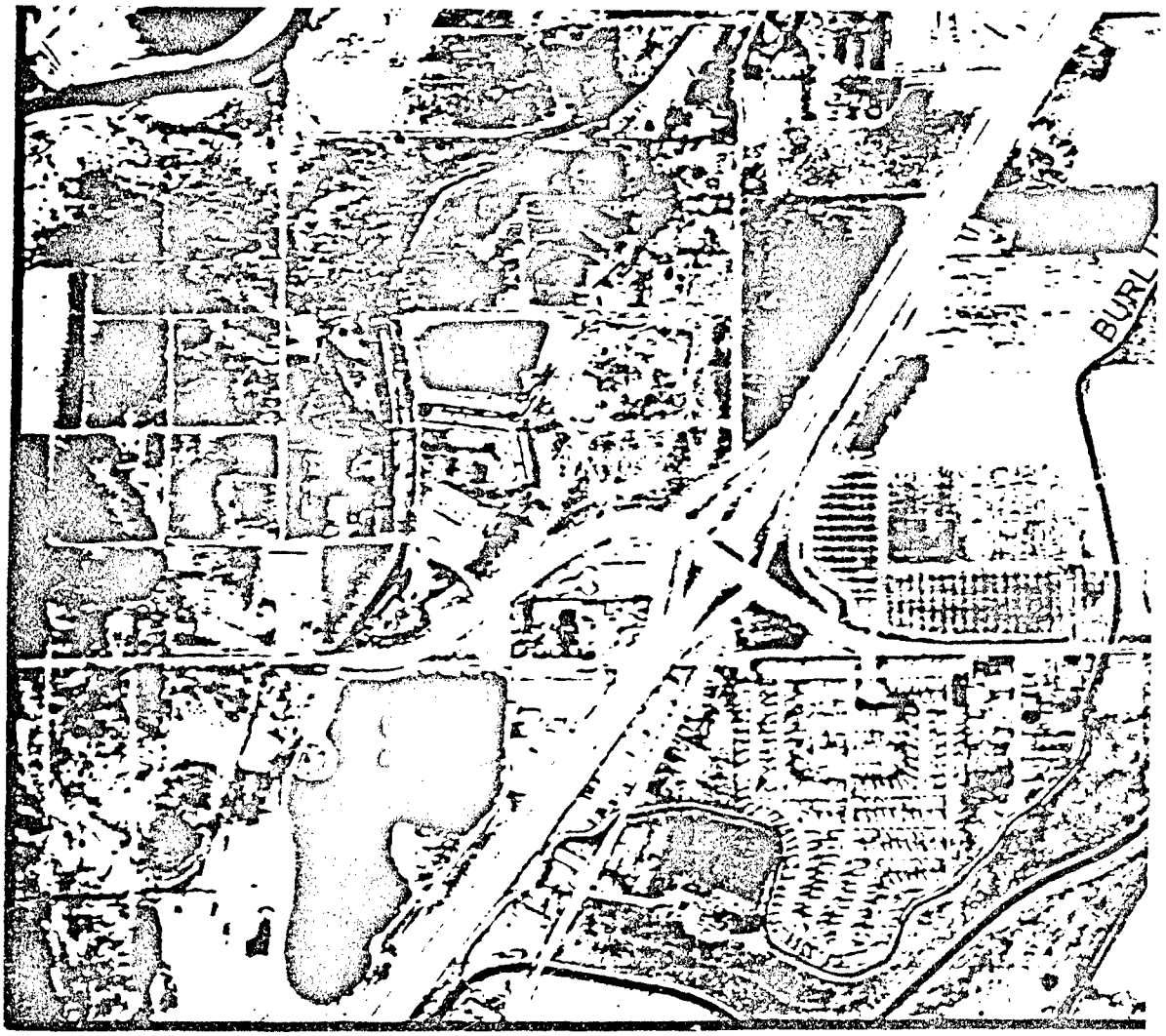

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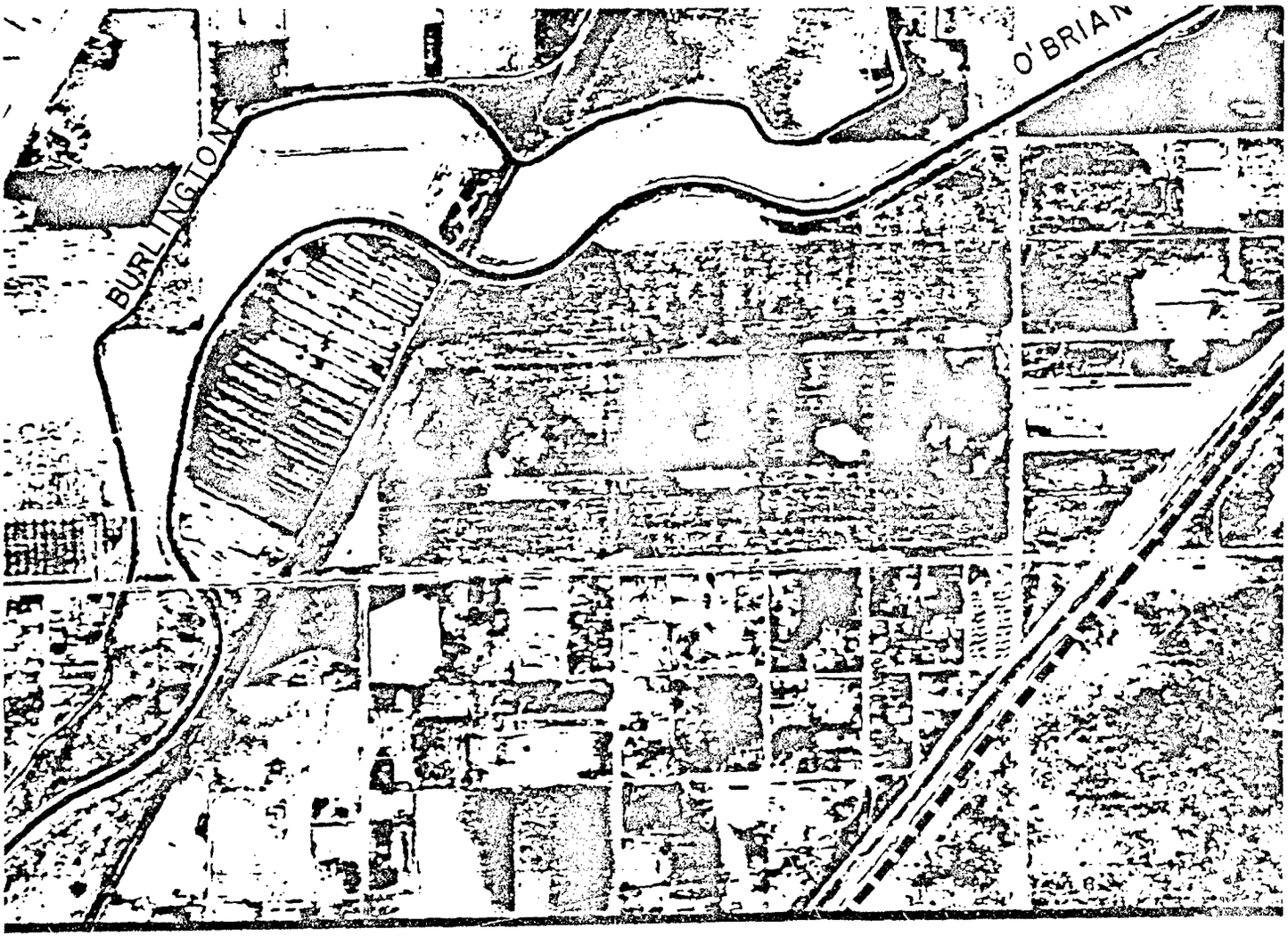

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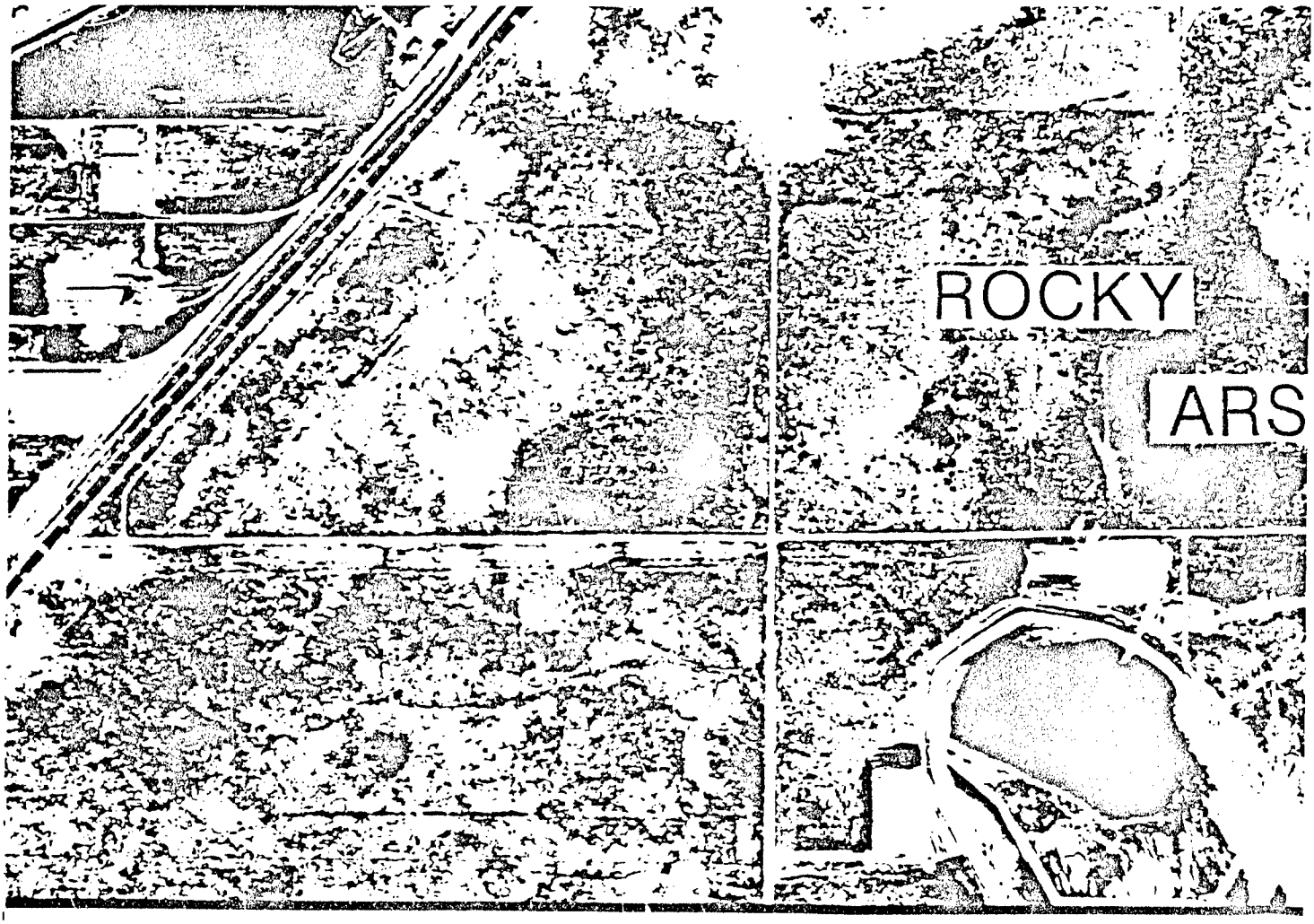

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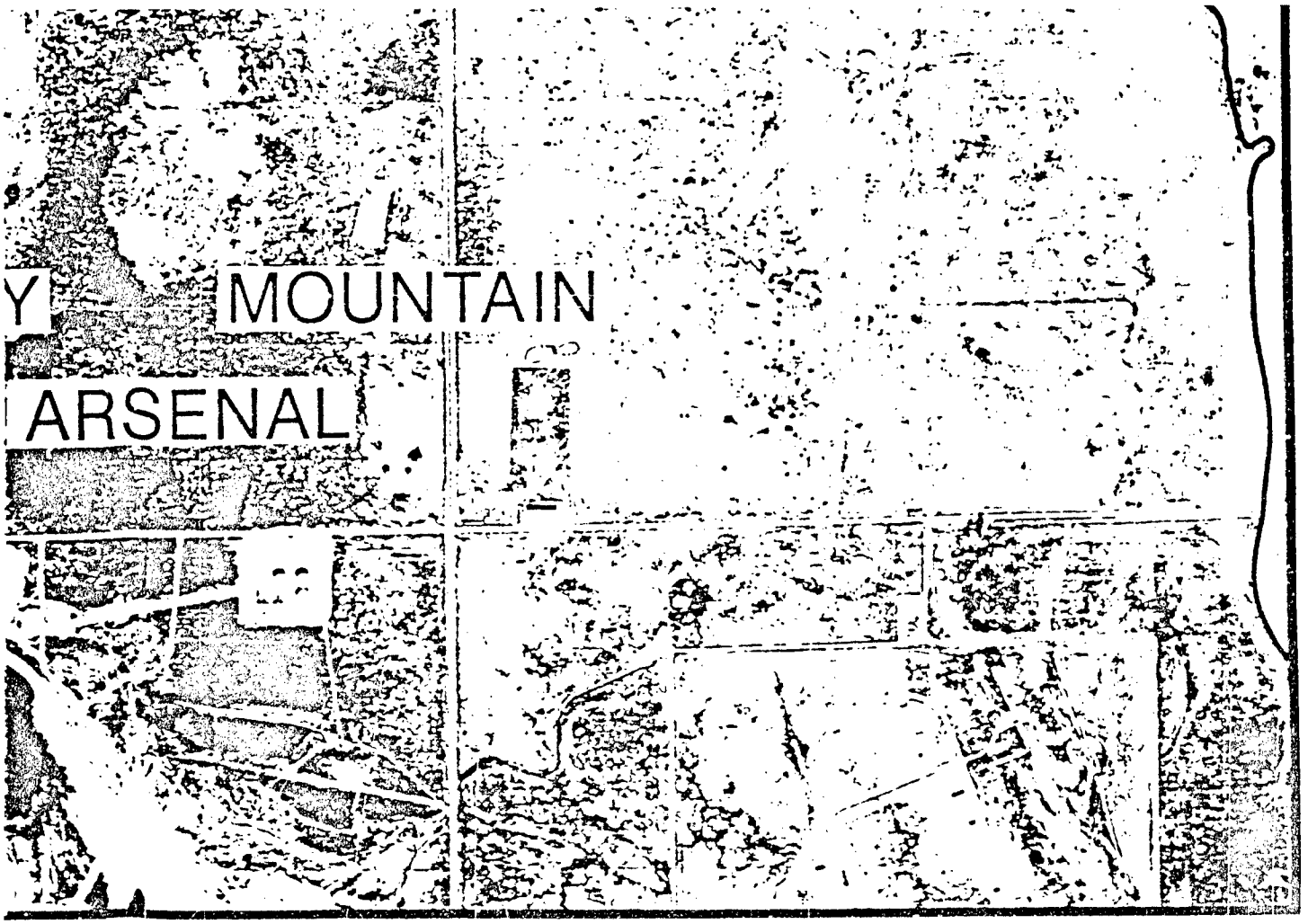

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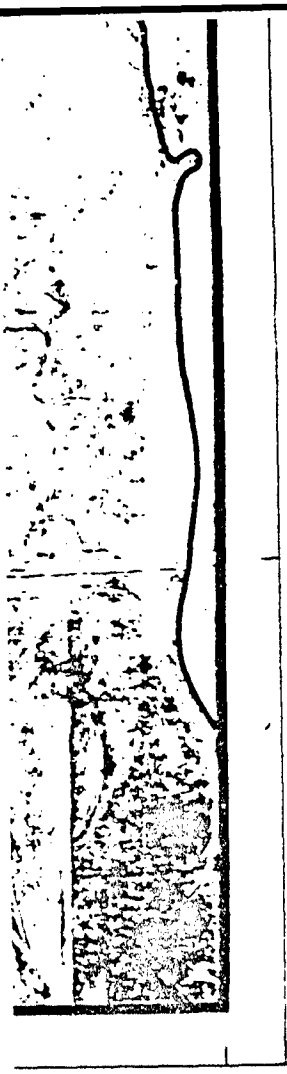

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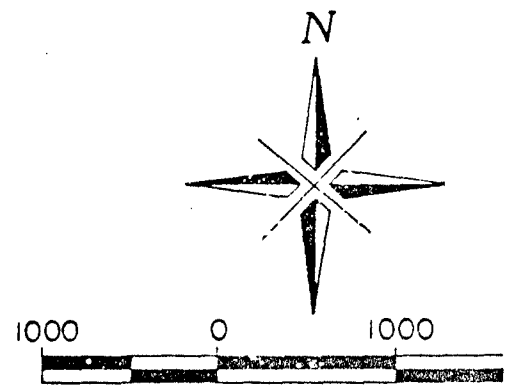

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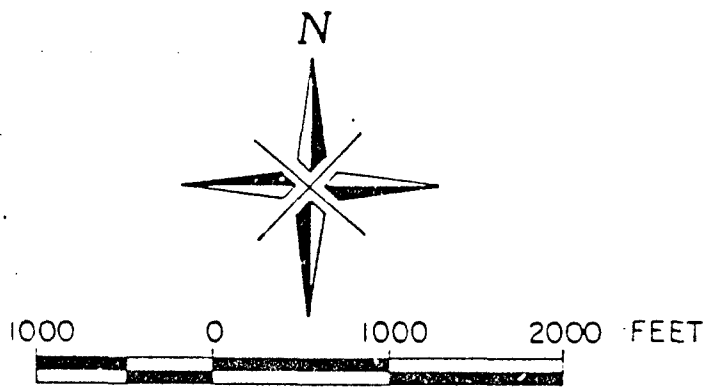

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REVISED BY MIKE HEYWOOD (2-12-90)

ATTACHMENTS

ATTACHMENT A

HEALTH AND SAFETY PLAN

DRAFT FINAL

HEALTH AND SAFETY PLAN

ROCKY MOUNTAIN ARSENAL

OFFPOST PRIVATE WELL INVENTORY,

SAMPLING

AND

INFORMATION RESPONSE PROGRAM

PREPARED BY

TRI-COUNTY HEALTH DEPARTMENT

February, 1991

TABLE OF CONTENTS

DRAFT FINAL

HEALTH AND SAFETY PLAN

ROCKY MOUNTAIN ARSENAL

OFFPOST PRIVATE WELL INVENTORY,

SAMPLING

AND

INFORMATION RESPONSE PROGRAM

February, 1991

1.0 INTRODUCTION

This Health and Safety Plan (HSP) establishes guidelines and requirements for the safety of field personnel during the performance of the field activities associated with the Tri-County Health Department (TCHD) Work Plan. This HSP is developed in accordance with appropriate OSHA regulations, 29 CFR 1910.134 and 29 CFR 1910.120.

The health and safety (H&S) requirements presented in this HSP are based on a review of the available information on potential contamination sources in the inventory area and an evaluation of potential hazards. This plan outlines the H&S procedures and equipment required for activities in the inventory area to minimize potential for exposures of field personnel to contamination sources.

1.1 Investigation Area Description and History

The purpose of the Work Plan is to provide limited ground water investigation results for the area bounded on the south by East 80th Avenue (offpost areas only) on the west by the South Platte River, on east by Second Creek, and on the north by the convergence of Second Creek with the South Platte River (Figure 1). The few alluvial wells in the area along First Creek between 96th Avenue and about one quarter of a mile north of 104th Avenue are located in an area of higher alluvial aquifer contamination, and will not be sampled because sufficient existing data is available for this area from the numerous Army monitoring wells routinely sampled in 1985, 1987 and 1989) for previously performed alluvial ground water investigations in the area, indicated the maximum potential concentrations in parts per billion (ppb) of the following chemicals (ESE, et.al, 1989):

- Diisopropylmethylphosphonate/Dimethylmethylphosphonate (DIMP/DMMP) - by-products from Army manufacture of GB-or Sarin nerve gas (isopropyl methyl phosphonofluoridate) during World War II, (maximum expected concentration of DIMP in the areas to be investigated is 630 ppb),

- Chlorinated pesticides (aldrin, dieldrin, endrin) - manufactured by Shell and other leaseholders, (maximum expected concentration for aldrin and dieldrin are 0.1 and 1.6 ppb respectively),

- Benzene - a solvent from one or more numerous possible sources, expected to occur only within Area Ib south of 96th Avenue (maximum expected concentration 1.5 ppb),

- Chloroform - a solvent from one or more numerous possible sources, expected to occur only within Area Ib south of 96th Avenue (maximum expected concentration of 24 ppb),

- Trichloroethene (TCE) - a solvent from one or more numerous possible sources, expected to occur only within Area Ib south of 96th Avenue (maximum expected concentration of 7.7 ppb),

- Tetrachloroethene (PCE) - a solvent from one or more numerous possible sources, expected to occur only within Area Ib south of 96th Avenue (maximum expected concentration of 5.5 ppb).

Concentrations of these chemicals in wells to be sampled, are expected to be well below the above listed maximum concentrations.

1.2 Key Personnel

All key personnel are TCHD staff members as follows:

Supervisor : Ken Conright (303) 288-6816 X22

For this Project the Supervisor has the following responsibilities:

- To finalize and approve work plans to meet project requirements.

- To provide resources to complete the project.

- To approve contractual agreements.

The Project Supervisor has the authority to take the following actions:

- To suspend project actions.

- To direct changes on project activities, schedule cost, personnel assignments, subcontracts and HSP.

Project Managers : Kathryn Cloutier (303) 288-6816 X23
Daniel Collins (303) 288-6816 X42

For this Project, the Project Managers have the following responsibilities:

- To see that the project is performed in a manner consistent with the Work Plan and appropriate Health and Safety regulations.
- To have an approved HSP prepared and properly implemented for this project.
- To implement the HSP.
- To ensure compliance with the HSP by TCHD and contractor personnel.
- To coordinate with the TCHD Health and Safety Officer on health and safety matters.

The Project Managers have the authority to take the following actions:

- To temporarily suspend field activities, if the health and safety of personnel are endangered, pending further consideration by the Project Supervisor.
- To temporarily suspend an individual from field activities for infractions of the HSP, pending further consideration by the Project Supervisor.

Health & Safety Officer (HSO):

Michele Rumbaugh (303) 220-9200 X67

The HSO has the following responsibilities:

- To interface with the Project Managers as may be required in matters of health and safety.
- To develop an HSP for the project and to submit it to the Project Managers and Project Supervisor for approval.
- To appoint or approve a Site Safety Officer (SSO) to assist in implementing the HSP.
- To monitor compliance with the approved HSP.
- To assist the Project Managers in seeing that proper health and safety equipment is available for the project.
- To approve personnel to work on the site with regard to health and safety training.

The HSO has the authority to take the following actions:

- To suspend work or otherwise limit exposures to personnel, if the HSP appears to be unsuitable or inadequate.

- To direct personnel to change work practices, if they are deemed to be hazardous to health and safety of personnel.

- To remove personnel from the project, if their actions or condition endangers their health and safety or the health and safety of co-workers.

2.0 WORK PLAN

For the purposes of this HSP, the field activities included in this project are grouped based on degree of potential contact of field personnel with inventory area-related contaminated materials. The following grouping of field activities by degree of exposure has been made:

Minimal or No Waste Contact Activities

- Well sampling via tap samples, and

- Preparation of samples for shipment.

3.0 HAZARD ASSESSMENT

An assessment of the potential hazards has been made for the field activities specified in Section 2.0. Suspected physical, biological, flammable and chemical hazards were identified as discussed in the following sections. For the field activities listed in Section 2.0 the following potential hazards have been identified, for which preventive measures are discussed in this HSP:

- Physical hazards associated with outdoor exposure (heat/cold stress) electrical hazards and tripping hazards,

- Biological hazards such as mosquitoes, snakes and ants,

- Inhalation of low concentrations of organic vapors and/or contaminated dusts,

- Skin and eye contact with organic contaminants, and

- Ingestion of organic contaminants.

3.1 Physical Hazards

The primary physical hazards anticipated to be potential risks to field personnel are heat and/or cold stress, depending upon the time of year in which sampling activities occur. Other physical hazards may include

cuts, trips, falls, and potential electrical hazards. Personnel should be cognizant of the fact that when personal protective equipment (PPE) such as respirators, gloves, and protective clothing are worn, (if any), visibility, hearing, and manual dexterity are impaired which would increase the potential for trips, falls and other accidents in general. Because minimal PPE is expected to be employed, and due to the residential nature of the investigation area, potential risks related to heat/cold stress are not expected to occur.

3.2 Biological Hazards

Numerous types of pest organisms may be present, including mosquitoes, snakes and ants. Mosquitoes may be prevalent at the site. Field personnel may use insect repellants before donning PPE. To avoid snake bites, personnel should check for snakes before walking through grassy or debris strewn areas. A first aid kit and insect treatment will be available for use in the field.

3.3 Flammable Hazards

Flammable hazards are not anticipated to occur during the course of field activities associated with the Work Plan.

3.4 Chemical Hazards

Personnel may be exposed to chemical hazards during field activities through four potential routes of exposure: inhalation, ingestion, skin contact and eye contact.

There are several potential inhalation hazards related to the field activities. Exposure to relatively low concentrations of these contaminants may occur during the field activities in the inventory area. Table 1 lists the Permissible Exposure Limits (PELs), Immediately Dangerous to Life and Health (IDLH) concentrations, and carcinogenicity for some of the most prevalent potential air contaminants that may be contacted in the inventory area (ground water).

PELs and TLVs are the concentrations of air contaminants that most workers can be exposed to for a 40-hour work week on a permanent basis with no significant health effects. If the concentra-tion of a contaminant on site exceeds its PEL, the appropriate form of respiratory protection should be used.

IDLH are concentrations that represent the maximum level from which one could escape within 30 minutes without any impairing symptoms or irreversible health effects. Level C air-purifying respirators and personal protective clothing do not protect an individual at IDLH concentrations. In addition, air-purifying cartridges are not effective for protection against certain compounds at levels above the PELs due to rapid break

through and/or inadequate warning properties. IDLH conditions are not expected to be encountered during the course of the field activities.

Limited air quality monitoring as specified in Section 6.0 will be used, as deemed necessary, to assess if the correct type of respiratory protection is being used. No routine air quality monitoring or respiratory protection is expected to be required for routine field activities.

Ingestion of chemical hazards will be controlled in the sampling areas by prohibiting any eating, smoking or drinking in the sampling areas and by requiring all field personnel to wash (decontam-inate) themselves upon leaving the sampling areas. Drinking of liquids should not take place in the sampling areas and only after partial decontamination (washing of hands) has taken place, except in a heat stress emergency situation.

Skin and eye contact with some of the chemicals that may be present in the ground water to be sampled may cause irritations. Some of these com-pounds may be absorbed into the bloodstream through the skin or eyes.

Any portion of the body which comes in contact with potentially contaminated ground water or other materials should be washed with soap and rinsed immediately. All field personnel should report any skin or eye contact symptoms to the TCHD occupa-tional health specialist (HSO) so that the person can be treated by a physician and steps can be taken to eliminate similar exposures.

Potential hazards may be minimized by protecting against exposures to toxic materials via the use of appropriate PPE. PPE to protect the body against contact with known or anticipated chemical hazards has been divided into four categories by the EPA (i.e., Level A, B, C and D) according to the degree of protection afforded.

Field activities have been grouped by the level of protection required (only one grouping applies to the field activities of this investigation). The following guidelines apply to each level of protection group.

The level of protection selected for field activities specified in Section 2.0 in the inventory area is a Level D with no routine air monitoring. An upgrade to Level C is required if non-routine activities are performed, which require air monitoring, unless initial monitoring results indicate otherwise (Section 6.0). This level of protection was selected because the potential types of airborne substances will be known, tap samples only will be taken, the work zone is outdoors (well ventillated), and minimal or no known respiratory hazards are expected to be encountered.

4.0 GENERAL HEALTH AND SAFETY REQUIREMENTS

4.1 Work Zones

To minimize the movement of contaminants from the sampling area to uncontaminated areas, two types of work zone areas will be established at the well site. The two types of work zones will include the following:

- Sampling areas, and
- Hand-washing/equipment cleanup areas (decontamination).

4.2 Personnel and Equipment Cleanup Procedures

The following steps must be taken for cleanup after each well is sampled:

- Deposit sampling/field equipment on plastic drop cloths, wash equipment in detergent and rinse with deionized water.
- Remove disposable gloves and discard.
- Wash hands with soap and water.

Waste liquids and gloves from the cleanup area are not deemed to be contaminated but are used primarily for sample integrity. These wastes will be disposed of using conventional methods for nonhazardous materials.

4.3 Prohibitions

Smoking, eating, drinking, chewing gum or tobacco, storing food or food containers, or application of cosmetics will not be permitted in the sampling areas. Good personal hygiene should be practiced by field personnel to avoid ingestion of contaminants or spread of contaminated materials.

Drinking fluids will take place only outside of the sampling areas and only after hand-washing has taken place. Drink breaks will be scheduled as needed to prevent heat stress in warm months.

4.4 Safety Equipment Provided

The following PPE will be provided to personnel engaged in the sampling activities specified in Section 2.0:

Minimal or No Waste Contact Activities Protection

- Boots/shoes, steel toe (optional), and
- Viton or vinyl gloves (viton to be used in TCE/PCE areas south of 96th Avenue only).

Respirators are not deemed necessary for routine well sampling procedures.

In addition to the PPE listed above, the following general safety equipment will be provided by the field personnel: first aid kit (with band-aids, antiseptic, etc.), portable eyewash (4 minute minimum flow), face and hand wash facilities, and insect repellant/treatment.

4.5 Health and Safety Training

All personnel potentially exposed to hazardous substances, health hazards or safety hazards shall be trained as specified in 29 CFR 1910.120(e). This includes attendance of an initial 40-hour basic health and safety training course, a minimum of three days of actual field experience under the direct supervision of a trained, experienced supervisor, and on-site, site specific training. Site specific training will be performed by the TCHD Project Managers.

4.6 Incident Reporting

Any incident or accident involving field personnel will require that an Incident/Accident Report be filed. Situations covered by this policy include but are not limited to fires, explosions, illnesses, injuries, and automobile accidents. These reports must be sent to the Project Supervisor within 24 hours of the incident/accident. Worker's Compensation Insurance reports should be filed with the individual's employer within 48 hours of each accident or illness which results from work-related activities and requires medical attention.

4.7 Compliance Agreement

The Project Supervisor will hold a project-related H&S review meeting with all field personnel before work commences. During the meeting, all personnel will be provided with a copy of this HSP; the plan will be reviewed and discussed and questions answered. Signed Compliance Agreement Forms (Section 8.0) will be collected by the Project Supervisor and filed. Individuals refusing to sign the form will not be allowed to perform field activities.

5.0 PERSONAL PROTECTIVE EQUIPMENT

5.1 Skin Protection

Disposable, chemically-resistant gloves must be worn by all personnel engaged in the sampling activities in the investigation area. Gloves will be disposed of at least after each use or when they become worn or punctured. The materials selected are expected to be resistant to known or anticipated significant chemical concentrations in the investigation area.

5.2 Foot Wear

Chemically-resistant boots or shoes with steel toes are recommended (but not required) to be worn by field personnel engaged in all field activities.

5.3 Respiratory Protection

Respirators are not expected to be needed.

6.0 AIR QUALITY MONITORING

Because only tap water samples will be taken (well casings are not to be directly accessed), and sampling will occur outdoors (well-ventilated area), the potential for contact with respiratory hazards from ground water sampling activities is deemed to be very low. Air quality survey procedures are not deemed to be necessary during routine sampling procedures. If unusual sampling conditions indicate a potential for respiratory hazards to be encountered, an air quality survey will be developed and performed prior to unusual sampling activities.

7.0 EMERGENCY RESPONSE PLAN

The purpose of this portion of the HSP is to address how site personnel will respond to emergencies. The types of potential emergencies that will be addressed by this plan include:

- Chemical exposures to personnel; and
- Physical injuries to site personnel.

Releases of chemicals to the environment which would impact the general public, property, or the environment are not anticipated during this project since the work will take place in areas which contain relatively low levels of contamination, and if present, such contamination is only expected to occur in ground water. Normal cleanup procedures (decontamination) as specified in Section 4.2 will be followed.

7.1 Chemical Exposures

Where possible, work shall be performed in such a manner that exposure to contaminants through skin or eye contact, inhalation or ingestion is minimized. Work practices that shall be followed to reduce chemical exposures include:

- Gloves as specified in Section 4.4 will be used by personnel during sampling activities,
- Hands will be kept away from face during work activities.
- Skin and eye contact with potential contaminants

will be minimized.

- Chewing gum or tobacco; drinking except in designated areas; eating; smoking: and applications of cosmetics will not be permitted during sampling activities.

Early recognition of chemical exposure symptoms is essential to the prevention of serious chemical exposure incidents. Symptoms of exposure to the types of compounds potentially present in the RMA investigation area include the following:

- Organic Solvents (e.g., TCE, PCE) : Skin, respiratory and eye irritation; headache; fatigue; dermatitis; flushed face; dizziness; and abdominal pain.

- Chlorinated Pesticides : Eye, nose, and/or throat irritation; headache; dizziness; nausea; vomiting; malaise; tremors; aggressive confusion; cyanosis (blue color to skin); anemia; and muscle spasms.

If a person experiences any of these symptoms or recognizes any of the symptoms in a fellow worker, the person experiencing the symptoms shall stop work and report his or her symptoms to the Project Supervisor. If the symptoms persist or appear to be damaging in any way, the Project Supervisor will make arrangements to take the individual to a hospital for medical treatment. If symptoms are serious, work activities in the area where the person was exposed will be discontinued until more is known about the incident. Incident reporting procedures as specified in Section 4.6 will be initiated.

7.2 Physical Injury

Site personnel should constantly look for potential safety hazards such as holes or ditches; precariously positioned objects, such as drums or equipment that may fall; sharp objects, such as nails, metal shards, and broken glass; protruding objects at eye or head level; slippery surfaces; steep grades; uneven terrain or unstable surfaces, such as walls that may cave-in or flooring that may give way. Site personnel should inform the Project Managers if any potential hazards are identified so that mitigative action can be taken.

7.3 Emergency Medical Treatment and First Aid

On-site medical treatment or first aid will be administered by the Project Managers or field personnel who are certified in First Aid and CPR.

The telephone numbers and locations of local emergency services are given below and in the attached emergency route to the hospital (Figure 1).

Emergency Service	Telephone Number
Fire Department/Ambulance	(303) 288-0835
Adams County Sheriff	(303) 289-4335
Poison Control Center	(303) 629-1123
ACCORD Medical Center (Worker's Compensation)	(303) 426-2020 (St. Anthony North)

7.4 Emergency Response Personnel

If any emergency such as a fire, chemical exposure, or physical injury occurs, the Project Supervisor shall be immediately contacted. The Project Managers will have certification in First Aid and CPR. The Project Supervisor can request additional assistance by telephone.

8.0 SAFETY PLAN COMPLIANCE AGREEMENT

I, _____ (print name), have received a copy of the Health and Safety Plan for TCHD RMA-Supplemental Tasks. I have read the plan, understand it, and agree to comply with all of its provisions. I understand that I could be prohibited from working on the project for violating any of the safety requirements specified in the plan.

Signed:

_____ _____

(Signature) (Date)

REFERENCES

Environmental Science and Engineering, Inc. (ESE), 1985. Rocky Mountain Arsenal Offpost Assessment. Ground Water Quality Report (Consumptive Use - Phase I) for Sampling Period, December 1984 through January 1985. Prepared for U.S. Army Toxic and Hazardous Materials Agency.

Environmental Science and Engineering, Inc. (ESE), 1986. Rocky Mountain Arsenal Offpost Assessment. Ground Water Quality Report (Consumptive Use - Phase II) for Sampling Period, September through October 1985. Prepared for U.S. Army Toxic and Hazardous Materials Agency.

Environmental Science and Engineering, Inc. (ESE), 1987. Rocky Mountain Arsenal Offpost Assessment. Ground Water Quality Report (Domestic Use - Phase III) for Sampling Period, September through October 1986 and February 1987. Prepared for Office of the Program Manager, Rocky Mountain Arsenal.

Environmental Science and Engineering, Inc. (ESE) and Harding Lawson Associates, 1988. Offpost Operable Unit Remedial Investigation and Chemical Specific Applicable or Relevant and Appropriate Requirements, Final Report (Version 3.1) Volumes I, II, and III.

Environmental Science and Engineering, Inc. (ESE) and Harding Lawson Associates, 1989. Offpost Operable Unit Endangerment Assessment/Feasibility Study with Applicable or Relevant and Appropriate Requirements, Draft Final Report (Version 2.1) Volumes I and II, March, 1989.

TABLE 1

PUBLISHED PEL* AND IDLH** CONCENTRATIONS OF SELECTED COMPOUNDS AT THE SITE

Compound	ACGIH TLV (ppm)*	OSHA PEL (ppm)**	IDLH (ppm)***	Carcinogen****
Benzene	10	1	3000	Yes
Chloroform	10	2	1000	Yes
DIMP	None Defined	None Defined	None Defined	Unknown
PCE	50	25	500	Yes
TCE	50	50	1000	Yes

* TLV — American Conference of Governmental Industrial Hygienists (ACGIH), 1990-1991, Threshold Limit Values, time weighted average.

** PEL — Occupational Safety and Health Administration (OSHA), Permissible Exposure Limits are work shift time weighted average levels. Most workers can work a 40-hour work week on a permanent basis at these concentrations with no significant health effects.

*** IDLH — Immediately Dangerous to Life and Health. These concentrations represent a maximum level from which one could escape within 30 minutes without any escape impairing symptoms or irreversible health effects. Level C air purifying respirators do not protect an individual from these concentrations.

**** National Institute for Occupational Safety and Health (NIOSH), June 1990, recommends that these compounds be treated as potential human carcinogens.

ATTACHMENT B

GROUND WATER MONITORING

FIELD OPERATING PROCEDURES PLAN

AND EXAMPLE FIELD FORMS

GROUND WATER MONITORING

FIELD OPERATING PROCEDURES PLAN

The field procedures discussed herein will be followed for private well ground water monitoring by Tri-County Health Department (TCHD) staff. Procedures for containeration and preserving ground water samples, and completing of chain-of-custody and shipping forms are discussed.

1.0 INTRODUCTION

Field personnel for ground water monitoring will consist of a two-person team. One member of the team will be designated as field supervisor and be responsible for ensuring that chain-of-custody records are maintained and will supervise or expedite sample collection, handling, packaging and shipment.

2.0 FIELD EQUIPMENT

Field personnel will obtain copies of the TCHD Health and Safety Plan (HSP), Field Operating Procedures Plan and the field kit, equipment list, including field sampling instruments (with owner's manuals), sampling equipment and documented calibration standards. The components of each field kit will be contained within a 100 quart cooler/locker and will include the following:

1. pH and conductivity meters; a complete set of probes, cables, and spare batteries for each instrument.

2. Digital alkalinity and hardness titration kits and chemical reagents (e.g. sulfuric acid cartridges 1.6N, phenolphthalein pillows, Bromcresol green-methyl red pillows, EDTA Cartridges 0.8N, Manver 2 pillows, Buffer Solution Hardness 1).

3. Labeled calibration standard solutions (conductivity, alkalinity, pH buffers 7 and 10) and de tailed calibration procedure instructions for all instruments.

4. Two 1-liter wash spray bottles and a set of two 500-milliliter (ml), two 250-ml, and two 100-ml beakers (labeled for pH buffers and standard solutions, etc.).

5. A water-level measuring device.

6. 100-foot measuring tape.

7. A roll of 10 mil plastic sheeting.

8. About 50 pairs of gloves (latex or vinyl) per day.

9. Box of kitchen size plastic bags.

10. A metals filtration kit; peristaltic pump, 50 feet of extension cord, 0.45 micron cellulose acetate filters, DC/auto battery connector cables, replacement silicon tubing, 50 ml of dilute nitric acid (HNO3) in 2-3 dropper bottles and pH indicator strip papers for ICP metals, arsenic and mercury sample preservation.

11. A complete set of spare sample fraction bottles (extra sample bottles).

12. About 50 ml of a 1:1 solution of sulfuric acid (H2SO4) for nitrate sample preservation in 2 dropper bottles.

13. Various equipment and records, such as business cards, survey forms, release signature forms, indelible ink marking pens, duct tape, clear tape, paper towels, watch, well file folders, large waterproof bags, evidence tape, clipboard, tissue papers or lens papers, calculator, and tools for troubleshooting equipment.

14. One cooler for each sample to be taken with sample fraction bottles, bubble wrap, chain-of-custody forms, laboratory mail label, and cool packs.

15. About 50 ml of sodium hydroxide (NaOH) solution in dropper bottles for cyanide sample preservation.

16. Field log book, map of area, list of well locations to be sampled, aerial photo Section map for each well location to be sampled.

17. Emergency eyewash, portable First Aid kit, and safety glasses.

18. Distilled water (five gallon glass bottle).

19. Mobile phone (charged battery).

20. 75 to 100-foot garden hose.

21. 5-gallon bucket with one-gallon increments.

22. Copy of Health & Safety Plan with emergency phone numbers, and copy of Field Operating Procedures.

23. Field log book, map of area, list of well locations to be sampled.

24. Camera and film (check battery).

Each field kit will be restocked as necessary by the field team at the close of each day of sampling. Additional field equipment (e.g. distilled water, standard solutions, preservatives, etc.) will be re-stocked as necessary by each field team.

Prior to start-up of field work, the on-site field supervisor will be responsible for ensuring that all field personnel are trained to operate all field equipment and understand the field procedures described herein. If procedures are modified or additional equipment or instrumentation is incorporated into the ongoing program, the field supervisor will schedule training sessions to introduce these modifications or equipment changes to field personnel and provide them written instructions.

Data from samples collected in the field will be recorded on preprinted field data sheets and in bound field logbooks. When not in use, field logbooks will be maintained by the field supervisor in a secured area. Logbooks will be checked in and out by the field supervisor to the field personnel on a daily basis. Examples of preprinted field data sheets for sample collection, and chain-of-custody are presented in Figures 1 and 2.

3.0 GROUND WATER SAMPLING PROCEDURES

The field supervisor will prepare a daily schedule of field activities and is responsible for providing a prepared sample cooler for each well sampling location, including QA/QC samples. Each cooler will contain sample containers, packing material, bottle labels, frozen cool packs, and chain-of-custody forms. The field supervisor will ensure that sample and field kits are complete and that all instruments and sampling equipment are clean and fully operative.

Upon arrival at the well site, the following procedures will be implemented:

1. Once at the sampling location, the field log book records will be completed with well number, well location (address), well depth, time of startup of each activity, date, pertinent observations (e.g., weather, well condition), field instrument identification numbers, sampling personnel names, level of protection, and page numbers. Have the well-owner sign a release form giving TCHD permission to sample the well.

2. Calibrate field instruments used for monitoring pH and conductivity, using known standard solutions. Record instrument calibration responses, times, and calibration standards used in field log book.

3. A portion of the initial water discharge (purged) from the well will be collected in a calibrated container, the purge rate estimated and the following information recorded: field parameter values (pH, temperature, and conductivity, and time of instrument readings, estimated pumping rate, and total purged volume removed. Purge water will be discharged away from the residence or building using a garden hose. Sampling indoors is acceptable with the owners permission.

4. Wells will be purged for approximately 45 minutes

or until field parameter values have stabilized. Field parameters will be checked and recorded in the field log book about every 9 minutes during the purging.

5. An alkalinity titration will be performed on a portion of the well water obtained after the fifth or final casing volume has been removed. Alkalinity titration values required to reach calorimetric end points will be recorded along with associated pH values (measured simultaneously).

6. Sample parameters of pH, temperature, conductivity and hardness will also be measured and recorded immediately prior to sample collection. Sample labels will be completed to include the following information: well number, time, date and sampler's full signature.

7. Samples will be collected directly from a sampling spigot (hose removed) at low flow rates to avoid agitating samples and possibly causing degassing of volatiles.

8. All sample bottles will be rinsed three times with sample water prior to filling. Sample fractions will be filled in the following sequence: (1) volatile aromatics (VOAs) (two 40-ml amber glass bottles); volatile organohalogens (VOHs) (two 40-ml amber glass bottles); (2) dibromochloropropane (DBCP) (one 250 ml amber bottle); (3) organosulfur compounds (one 1-liter amber glass bottles); (4) organochlorine pesticides (one 1-liter amber glass bottle); (5) phosphonates (one 1-liter amber glass bottle); (6) hydrocarbons (one 1-liter amber glass bottle); (7) anions (one 125-ml clear plastic bottle); (8) inductively-coupled plasma (ICP) metals (one 500-ml clear plastic bottle); (9) arsenic (one 500-ml clear plastic bottle); (10) mercury (one 500-ml clear plastic bottle); (11) cyanide (one 1-liter plastic bottle); (12) nitrate/-nitrite (one 125-ml clear plastic bottle); (13) gas chromatography/mass spectoscopy (GC/MS) volatile fraction (two 40 ml amber glass bottles); (14) GC/MS semi-volatile fraction (one 1 liter amber glass bottle). The VOC, VOH, GC/MS volatiles sample fractions will be filled completely and capped tightly to avoid air bubbles. Except for metals, all remaining sample fractions will be filled to a minimum of 90 percent capacity. The ICP metals, arsenic and mercury fractions will be filtered in the field using 0.45 micron cellulose acetate filters and preserved with dilute nitric acid to a pH of <2. Unfiltered nitrate fractions will be preserved with sulfuric acid to a pH of <2. Unfiltered cyanide fractions will be preserved with sodium hydroxide to a pH of >12. All sample fractions will be immediately placed in the cooler with frozen cool packs upon filling. Sampling technique, well depth, and fractions collected will

be recorded on field data sheets, chain-of-custody forms, and the sample tag. Sample bottles will be dried thoroughly, labelled, wrapped in bubble pack (secured with rubber band) and placed in cooler with frozen cool packs and sample paperwork (protected in waterproof bag).

9. The field supervisor will sign and date field sheets after ensuring that they have been completed and that the information has also been recorded in the field logbook. The field supervisor will complete chain-of-custody form when relinquishing custody of samples.

10. All sampling equipment will be thoroughly decontaminated at the well site prior to storage. Equipment will be cleaned in a solution of approved water and triple-rinsed with distilled water. To decontaminate the inside of the pump tubing, a volume of distilled water equal to three times the volume of the pump and tubing will be pumped through the line. All cleaned equipment will be dried, wrapped and stored in clean plastic sheeting or clean cases.

11. The final activities at the well will be to remove all sampling equipment and debris from the area, secure equipment and instruments in vehicles and record time sampling completed in field log book. Provide well-owner with field personnel business cards and approximate date that laboratory results are expected. The well location is then to be field-truthed on the Section map and paced from the nearest Section lines.

In addition to the above procedures, the following guidelines will be used to mitigate problems that could adversely affect sample integrity:

1. Avoid agitation of VOC samples collected. This will reduce air stripping of volatiles and allow for the collection of more representative samples. Check for air bubbles after taking samples by inverting the bottle. If an air bubble is present, resample.

2. Sampling equipment, should contact only the well water or a clean plastic surface. Equipment should never contact the ground or any other surface that has the potential to transmit contaminants. This equipment should always be encased or wrapped in clean plastic during transport.

3. Change gloves frequently when handling samples. Always change gloves after working with equipment prior to sampling. New gloves will be worn at the start of well purging and changed immediately prior to sample collection.

4. Vent gasoline engines downwind at least 30 feet

from the well. Gas tanks should never be filled in the field. Keep all sampling equipment and sample bottles away from areas where gasoline spills or leaks may occur.

5. Replace all dropped bottles, lids, or lid septa/-Teflon cap liners with extra counterparts from the kit. Avoid hand-contact with edges of lids or inside surfaces of sample bottles.

6. Ensure that septa/Teflon cap liners are in good condition. Check that septa are oriented with Teflon side down. When full, septa bottles should be transported upside down.

7. Avoid sampling when precipitation or windblown dust may contaminate the sample.

8. Do not dip pH indicator paper into acidified samples; check by pouring a small amount of sample on paper.

9. Check all documentation to ensure that corrections are properly recorded. Also check to see if all signatures and dates on forms are present and correct, properly signed, and dated.

10. In the field, the field supervisor checks all forms to ensure that they are readable, legible, and correct.

4.0 CHAIN-OF-CUSTODY

Chain-of-custody forms will be issued with corresponding sample kits by the field supervisor. These forms are an inventory of the samples and of those persons with access to the samples. The forms will be transported with the samples at all times. Possession of the samples will begin with the sample collectors. All subsequent sample transfers will require the relinquisher and the receiver to sign, date, and record the time of transfer on the chain-of-custody forms.

Data on chain-of-custody forms will be checked by the field supervisor and will include the sample number, sampler's full signature, collection date and time, fractions collected, and sample depth. The field supervisor will obtain these data from the field data sheets transmitted by the sampling personnel.

5.0 SAMPLE SHIPMENT

By the end of each sampling day, all samples should be brought back to the RMA sample handling trailer or TCHD office for packaging. The field supervisor will complete chain-of-custody forms and review field logbooks and field data sheets for errors and omissions.

Sample fractions will be repackaged with frozen cool packs in heavy-duty coolers to maintain sample temperatures of 4 degrees Celcius. Chain-of-custody forms will placed in

waterproof bags in their corresponding coolers. All coolers will be sealed and wrapped in accordance with individual shipping requirements. Evidence tape will be placed across each cooler to ensure that the contents are not violated during shipping. The last person to sign the chain-of-custody form for each cooler will sign and date the evidence tape. The chain-of-custody forms will be signed over to the transport courier, the samples will be shipped by air (Federal Express) freight to the laboratory on a daily basis to ensure that sample holding times are not exceeded.

EXAMPLE FIELD FORMS

CHAIN-OF-CUSTODY RECORD

	Project Name: TCHD RMA SUPPLEMENTAL OFFPOST PRIVATE WELL INVENTORY, SAMPLING, AND INFORMATION RESPONSE PROGRAM	Sample Date:	Site Type: TAP	Site Identification:
Samplers: (Signature)		Sample Depth: (ft)		Sample Technique:

TIME	TAG NO.	ANALYSIS REQUIRED	CONTAINER	PRESERVATIVE/REMARKS
		Vol Aromatics	40ml Amber Gl	
		Vol Aromatics	40ml Amber Gl	
		Vol OrganoHalogens	40ml Amber Gl	
		Vol OrganoHalogens	40ml Amber Gl	
		DBCP	250ml Amber Gl	
		Organosulfur Comp	1 Liter Amber Gl	
		Organochlorine Pest	1 Liter Amber Gl	
		Phosphonates	1 Liter Amber Gl	
		Hydrocarbons	1 Liter Amber Gl	
		Anions	125ml Plastic	
		Nitrate/Nitrite	125ml Pl	0.5ml H2SO4
		Cyanide	1 Liter Pl	1 ml NaOH
		N/P Pesticides	1 Liter amber Gl	
		Arsenic	500ml Pl (filt)	0.5ml HNO3
		Mercury	500ml Pl (filt)	0.5ml HNO3
		ICP Metals	500ml Pl (filt)	0.5ml HNO3

Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Airbill Number		

CHAIN-OF-CUSTODY RECORD

	Project Name: TCHD RMA SUPPLEMENTAL OFFPOST PRIVATE WELL INVENTORY, SAMPLING, AND INFORMATION RESPONSE PROGRAM	Sample Date:	Site Type: TAP	Site Identification:
Samplers: (Signature)		Sample Depth: (ft)		Sample Technique:

TIME	TAG NO.	ANALYSIS REQUIRED	CONTAINER	PRESERVATIVE/REMARKS
		Vol Aromatics	40ml Amber Gl	
		Vol Aromatics	40ml Amber Gl	
		Vol OrganoHalogens	40ml Amber Gl	
		Vol OrganoHalogens	40ml Amber Gl	
		DBCP	250ml Amber Gl	
		Organosulfur Comp	1 Liter Amber Gl	
		Organochlorine Pest	1 Liter Amber Gl	
		Phosphonates	1 Liter Amber Gl	
		Hydrocarbons	1 Liter Amber Gl	
		Anions	125ml Plastic	
		Nitrate/Nitrite	125ml Pl	0.5ml H2SO4
		Cyanide	1 Liter Pl	1 ml NaOH
		N/P Pesticides	1 Liter amber Gl	
		Arsenic	500ml Pl (filt)	0.5ml HNO3
		Mercury	500ml Pl (filt)	0.5ml HNO3
		ICP Metals	500ml Pl (filt)	0.5ml HNO3

Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Airbill Number		

COMPREHENSIVE MONITORING PROJECT/ROCKY MOUNTAIN ARSENAL

GROUND-WATER SAMPLING FIELD DATA SHEET

Log Book # CMP-____
Page _____ of _____

Well ID. No.	Purge Equipment	Analytical Equipment	Samplers Initials	Time	Date
	☐ Bennett Pump (Teflon Tubing) ☐ Isco Pump (Teflon Tubing) ☐ Standard Pump (PVC Tubing) ☐ Grundfos Pump (Neoprene Tubing) ☐ Stainless Bailer: O.D. / Length 1.65" ☐ ☐ 2 ft 1.85" ☐ ☐ 3 ft 3.75" ☐ ☐ 4 ft ____ ☐ ☐ ____ ft Serial No. _____	pH Meter: ☐ Beckman phi 21 ☐ Omega pH-65A ☐ Orion SA250 ☐ Other _____ Serial No. _____ Conductivity Meter: ☐ YSI Model 33 ☐ Other _____ Serial No. _____ Dissolved Oxygen Meter: ☐ YSI Model 51B Serial No. _____ Temperature Meter: ☐ Beckman ☐ Other _____ Serial No. _____ Filtration Equipment: ☐ Geotech Peristaltic Pump ☐ Geotech 0.45 micron filter Water Level Meter: Solinst RLSA # __ HLA # __			

Casing Diameter	Sample Equipment	Meter Calibration	Time
in.	☐ Same as Purge ☐ Bennett Pump (Teflon Tubing) ☐ Isco Pump (Teflon Tubing) ☐ Standard Pump (PVC Tubing) ☐ Stainless Bailer: O.D. / Length 1.65" ☐ ☐ 2 ft 1.85" ☐ ☐ 3 ft 3.75" ☐ ☐ 4 ft ____ ☐ ☐ ____ ft Serial No. _____	pH 7.00 = _____ at _____ °C _____ Time pH 10.00 = _____ at _____ °C _____ Conductance Standard: _____ umhos/cm at 25°C Time Measured Value: _____ umhos/cm at _____ °C _____ Calibrated Conductivity = Measured Conductance + (0.02) (measured conductance) (25°C - Actual Temp)): Time _____ umhos/cm at 25°C _____ Time Dissolved Oxygen _____ mg/l at _____ °C _____	
Casing Stickup ft			
Total Well Depth ft			
Static Water Level ft			
Saturated Thickness ft			
Casing Volume gal.			
Screened Interval ft			

Titration Results (Acid Concentration: ☐ 0.16, ☐ 1.6)

pH	7.0	5.1	4.8	4.5
#Clicks				
Color				

Time	Number of Casing Volumes	Gallons Removed	°C	E.C. umhos/cm	pH	Dissolved O_2 mg/Liter	Pump Rate GPM	Approx Pump Depth ft	Visual Description

ANALYSES REQUESTED	Volatile Aromatics	Volatile Organohalogens	DBCP	Organosulfur Compounds	Organochlorine Pesticides	Phosphonates	Hydrocarbons	Amons	Nitrate/Nitrite (@ 5 ml H_2SO_4)	Arsenic (@ 5 ml HNO_3)	Mercury (@ 5 ml HNO_3)	ICP Metals (@ 5 ml HNO_3)	Acid Extractables	Cyanide (1 ml NaOH)	GC/MS Volatiles	GC/MS SV/Acid Extractables	Met/Phos Pesticides	

HS Comments:

Sample Depth: (cm)

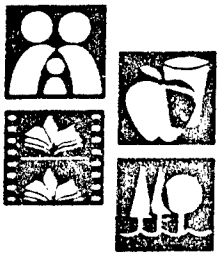
Protective Level: D C B

HSO Signature:

Condition of Well, Remarks:

Sampler Signature:

MFOP1441



Tri-County Health Department

Serving Adams, Arapahoe and Douglas Counties

Hugh Rohrer, M.D., M.P.H.
Director

RELEASE OF INFORMATION

Dear Owner/Resident:

The purpose of this survey is to provide a more detailed determination of the area impacted by Rocky Mountain Arsenal related chemicals and to provide data for regulatory and risk assessment purposes.

Any information Tri-County Health Department collects, such as general well information or demographics, by law is accessible to the public because to the Freedom of Information Act. To prevent this information from being obtained by inappropriate persons, residents or property owners only will receive specific information pertaining to their own property.

In signing this release I acknowledge the above:

Resident _____

Address _____ Date _____

Tri-County Health Department Representative _____

Date _____

4301 East 72nd Avenue ☐ Commerce City, Colorado 80022-1488 ☐ 303/288-6816

ATTACHMENT C

EXAMPLE FIELD SURVEY FORM

TASK 2: UPDATE AND AUGMENTATION OF

PREVIOUS TCHD WELL SURVEY

ATTACHMENT C

EXAMPLE

FIELD SURVEY FORM

TASK 2: UPDATE AND AUGMENTATION OF

PREVIOUS TCHD WELL SURVEY

PROPERTY/OWNER INFORMATION

TRI-COUNTY PROPERTY ID #: _____

ASSESSORS MAP ID #: _____

PROPERTY ADDRESS: _____

NAME OF OWNER: _____
(President if Corp.)

DATES OF OWNERSHIP: From _____ to _____

OWNER'S MAIL ADDRESS: _____

OWNER'S HOME PHONE: _____ OWNER'S WORK PHONE: _____

NUMBER OF WELLS ON PROPERTY: _____

DATE OF ORIGINAL SURVEY: _____

INQUIRIES (DATE): _____

TCHD RESPONSES (DATE): _____

TRI-COUNTY PROPERTY ID#: _____

RESIDENT INFORMATION

MAILING ADDRESS: _____

HOME PHONE: _____ WORK PHONE: _____

ID#	NAME	DOB	SEX	% OF DIET (HOMEGROWN): VEGETABLES	MEAT	DATES OF RESIDENCE
						from to
						from to
						from to
						from to
						from to
						from to

(*Head of household)

LOCAL HUNTING: (Circle One) YES NO TYPE OF GAME: (Circle One or More)

Doves Ducks Pheasants Rabbits Geese Deer Squirrels

DRINKING WATER SOURCE:
(may check more than one)

1) Community supply tap on property?: (Circle One) YES NO

If yes, is it used?: (Circle One) YES NO

(name) _____ Address _____

CDH PWSID _____

How many taps and/or number of people served? _____

2) Well _____ Well ID Number _____

3) Bottled _____ Source _____ How long? _____

4) Multi user well (2 or more) _____

5) Other _____

TREATED/TYPE
(Circle One)

YES NO

1) Softeners _____
2) Filters _____ Type _____
3) RO _____
4) Distillation _____
5) Chlorinated _____
6) Other _____

TRI-COUNTY PROPERTY ID#: _____

WELL INFORMATION

WELL NUMBER: _____

CLASSIFICATION NUMBER BASED ON THE FOLLOWING:

			4	3	2	1	0
a) Location:	A		Ia & Ib	II	III	IVa & IVb	Other
b) Use:	B	Community Supply or	Drinking Domestic	Non-Drinking Domestic	Crop Stock	Inedibles Irrigation	Other
c) Past test results:	C	*	DIMP or other RMA Compounds	Other RMA Compounds	Con-flicting Test Results	Never Tested	None De-tected
d) Depth	D	*	*	Shallow	Unknown	Deep	Other
e) Other		*	*	*	*	*	*

CLASSIFICATION = A + B + C + D C __ = __ + __ + __ + __

1 = 12-16 2 = 8-11 3 = 4-7 4 = 3-0

Circle one: 1 (Most Important)
2
3
4 (Least Important)

TOWNSHIP-RANGE-SECTION: _____

DISTANCE IN FEET FROM NEAREST TWO SECTION LINES (PACED IN FIELD): _____

_____

_____

STATE WELL PERMIT RECORD NUMBER: _____

DATE WELL CONSTRUCTED: _____

360 DEGREE PROGRAM WELL ID NUMBER: _____

SHELL WELL ID NUMBER: _____

ARMY WELL ID NUMBER: _____

ESE WELL ID NUMBER: _____

OTHER WELL ID NUMBER: _____

TRI-COUNTY PROPERTY ID#: _____

CONSTRUCTION TYPE (circle one): DRILLED HAND DUG

CONSTRUCTION COMMENTS: _____
(Unsealed casing, pit well, cracked casings, etc.)

CASING TYPE (circle one): STEEL PVC PLASTIC CONCRETE OTHER

SUSTAINED YIELD (GALLONS PER MINUTE, FROM DRILL LOG): _____

SCREENED INTERVAL (DEPTH IN FEET) FROM DRILL LOG: _____

AQUIFER DESIGNATION (circle one): 1) ALLUVIAL 2) DENVER

COMMENTS: _____ 3) ARAPAHOE 4) FOX HILL

_____ 5) UNKNOWN 6) QUESTIONABLE

REPORTED DEPTH OF WELL IN FEET: _____

SOURCE OF DEPTH INFORMATION (circle one): 1) WELL LOG
2) STATE PERMIT
3) FIELD MEASURED
4) OWNER REPORTED

EVER PREVIOUSLY SAMPLED FOR CHEMICALS? (circle one): YES NO

BY WHO? _____ DATE _____

TEST AND RESULT: _____

WANT SAMPLED? (circle one): YES NO

FOR WHAT TEST? (circle): AND TEST RESULTS/DATE:	TEST	RESULTS	DATE
	1) RMA-RELATED ANALYTES		
	2) BACTERIA		
	3) OTHER (SPECIFY): _____		

DATE OF FIELD ANALYSIS: _____

CONDUCTANCE (umhos/cm): _____ HARDNESS (ppm): _____

FLUORIDE (ppm)): _____ NITRATE (ppm): _____

RESULTS SENT? (Circle): RESIDENT OWNER / YES NO DATE SENT: _____

PHYSICAL EXAMINATION: TASTE _____, ODOR _____, APPEARANCE _____

CASING "STICKUP" IN FEET FROM GROUND SURFACE: _____

TRI-COUNTY PROPERTY ID#: _____

MEASURED TOTAL DEPTH OF WELL IN FEET (TO TOP OF CASING): _____

TOTAL DEPTH IN FEET CORRECTED TO GROUND SURFACE: _____

STATIC WATER LEVEL DEPTH IN FEET (TO TOP OF CASING): _____

WATER LEVEL IN FEET CORRECTED TO GROUNT SURFACE: _____

USES OF WELL (circle one): (or more)

1) COMMUNITY SUPPLY
2) DRINKING
3) DOMESTIC
4) CROP IRRIGATION
5) LIVESTOCK
6) NON-FOOD IRRIGATION
7) NONE
8) OTHER: _____

STATUS OF WELL (circle one):

1) IN USE
2) SEASONAL
3) UNUSED
4) DRY
5) SEALED

WELLHEAD LOCATION DESCRIPTION: _____

SAMPLING POINT LOCATION DESCRIPTION: _____

COMMENTS: _____

_____

_____

WEATHER CONDITIONS (e.g., rain in 24 hrs.) : _____

PERSON INTERVIEWED: _____ DATE INTERVIEWED: _____

TCHD EXAMINER'S INITIALS: _____ DATE SURVEY COMPLETED: _____

DEFINITIONS LIST

DEFINITIONS LIST (1)

Drinking water source:	Community: Name Well: Number Bottled: _____ None
Construction type:	Drilled Hand dug Unknown
Casing type:	Steel PVC Concrete Unknown Other: _____
Aquifer:	Alluvial Arapahoe Fox Hill Questionable Unknown
Source of depth:	Drill log Owner-reported State permit record Field measured Bedrock data map Other: _____
Treatment type:	Softener Filter: Paper, Carbon Reverse Osmosis Distillation Chlorination Other: _____
Uses:	Community supply: Name Non-Community supply: Name Drinking and domestic Domestic (no drinking) Crop irrigation Livestock Non-food irrigation None Other: _____
Status of well:	In-use Seasonal Unused Sealed Dry Other: _____

(1) This list defines the acceptable entry options for the field survey form and computer database for pertinent categories.